EVALUATIONS OF QUANTITIES OF BIOMEDICAL WASTE GENERATED IN ONTARIO

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for
Ontario Ministry of Environment and Energy

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Stewarts Westmount Pharmacy, Guelph
Thrifty's Drug Mart, Erin
Mount Forest Pharmacy, Mount Forest
Preston Medical Pharmacy, Cambridge
IDA Drug Stores, Cambridge

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EXECUTIVE SUMMARY

The Ontario Ministries of the Environment (MOE) and Health (MOH), in cooperation with the Ontario Hospital Association, are developing a comprehensive strategy to manage biomedical waste in the province. A detailed definition of biomedical waste, based on the definition adopted by the Canadian Council of Ministers of the Environment (CCME), has been developed in consultation with all stakeholders in order to clearly define what should be handled as biomedical waste in Ontario.

The strategy proposes the management of biomedical waste on a regional basis, defined by the six MOH planning regions. In order to develop regional plans for biomedical waste management facilities, a detailed assessment of the quantities of biomedical waste generated in each region is required.

The Ministry of the Environment contracted ORTECH International to undertake an audit of biomedical waste generated in the province, the results of which are presented in this report.

The results of the study are summarized in Table 1. The study estimated that 14,556 tonnes of waste are currently being disposed as biomedical by Ontario generators, 39% of which is not biomedical waste and does not require special handling. Hospitals account for about 67% of the biomedical waste currently disposed in the province. For hospitals, the proportion of non-biomedical waste currently disposed as biomedical was in the range of 46-68%. Funeral homes and coroners' offices were

also found to dispose 45-50% non-biomedical waste as biomedical. Most other generators surveyed disposed of very little non-biomedical waste as biomedical. With more stringent segregation practices, particularly in hospitals, the volume of biomedical waste requiring special handling at biomedical waste management facilities could be substantially reduced.

Sites participating in this study reported various issues and concerns with the proposed definition of biomedical wastes. These included: some confusion about the content and wording of the definition; how this new definition would be implemented by generators; and how the new definition fit with some of their internal infection control procedures. Since this definition will be used to determine what wastes must be managed as biomedical, and since the provincial strategy is to have regional facilities to manage this defined waste stream, it is important that health care practitioners understand and accept the definition. Since, also, the regional waste management facilities will be sized to deal with biomedical waste as defined, it is important for proper segregation of wastes to be practised.

Table 1
Provincial Estimates of Waste Categories
Currently Disposed as Biomedical Waste

Waste Category	Ontario Total Tonnes/year	% of Total
Biomedical	6,650	45.5
Animal Carcasses	1,530	10.5
Pharmaceuticals	265	2.0
*Contiguous:		
Blood Contaminated	421	3.0
Non-Biomedical	5,690	39.0
Total	14,556	100

*The term Contiguous refers to wastes contaminated with blood but not to the degree of being considered biomedical wastes. These wastes may be wrongly disposed by generators as biomedical.

1. INTRODUCTION AND BACKGROUND

Management of wastes resulting from the provision of health care to animals and humans, commonly termed 'medical wastes', presents many unique challenges and requires the development of a responsible strategy. One key element of such a strategy is a clear definition of the components of medical waste which require special handling so that it is understood by medical waste generators who will be responsible for segregating the waste. This will:

(a) ensure that no hazardous material is disposed in the general waste stream from health care facilities;

(b) minimize the quantities of waste that are deemed to need special handling; and

(c) that the audit of wastes needing special handling undertaken actually reflect generation rates, and that the results will allow an infrastructure for management of this waste to be designed.

The Ontario Ministry of the Environment, in conjunction with a group of stakeholders from both government and the health care sector, have a proposed definition for medical waste requiring special handling which they call "Biomedical Waste". The definition of this is reproduced on the following page. This is based on the definition of biomedical waste adopted by the Canadian Council of Ministers of the Environment (CCME) in February, 1992.

This definition was used to conduct this waste audit to determine how well waste is currently being segregated, and to quantify the amount of

PROPOSED DEFINITION OF BIOMEDICAL WASTE (see Appendix 4)

March 24, 1992

Biomedical Waste means waste that is generated by human or animal health care facilities, medical research and medical teaching establishments, health care teaching establishments, clinical testing or research laboratories, mortuaries, funeral establishments, facilities involved in the production and testing of vaccines, and includes wastes generated from mobile health care;

limited to:

(a) human anatomical waste consisting of human tissues, organs and body parts, not including teeth, hair and nails;

(b) animal waste consisting of all tissues, organs and body parts, carcasses, bedding, fluid blood and blood products, items saturated or dripping with blood, body fluids contaminated with blood, body fluids removed during surgery, treatment, necropsy, or for diagnosis, unless determined by the a trained person designated by the generator that the waste does not contain the viruses and agents listed in Schedule 5A;

(c) non-anatomical waste limited to:

i) cultures, stocks or specimens submitted for microbiological analysis, live or attenuated vaccines, cell lines, human or animal cell cultures used in research, and, material that has come into contact with the above,

ii) human liquid blood or semi-liquid blood and blood products, items contaminated with blood that would release liquid or semi-liquid blood if compressed, body fluids contaminated with blood, and body fluids removed during surgery, treatment, autopsy, or for diagnosis, but not including urine and faeces,

iii) sharps including needles, blades, and glass or other materials capable of causing punctures or cuts;

(d) other waste not included above which:

(i) are deemed by a trained person designated by the generator to require special handling, or

(ii) have come into contact with an individual being treated or suspected to be infected with one or more of the viruses or agents listed in Schedule 5B;

but does not include waste that is:

i) from animal husbandry,
ii) domestic waste,
iii) controlled in accordance with the Health of Animals Act (Canada), the Dead Animals Disposal Act (Ontario), the Research for Animals Act (Ontario), Meat Inspection Act (Ontario), or the Meat Inspection Act (Canada),
iv) generated in food production, general building maintenance or office administration of the aforementioned facilities.

biomedical waste generated. During the audit, health care workers' practices were observed and interviews were conducted to get their opinions on the proposed definition.

Another major issue to be addressed is the Ontario infrastructure for handling biomedical waste. Currently, all "anatomical waste" and most "non-anatomical biomedical waste" is incinerated. Some non-anatomical biomedical waste is currently being disinfected by autoclaving and then sent to sanitary landfill. Alternate treatment technologies for non-anatomical waste are being investigated.

Currently, no commercial biomedical waste incinerators exist in the province of Ontario. Many of the incinerators associated with individual health care facilities are antiquated and not state-of-the-art as far as emissions' control is concerned. Thus, the health care sector in Ontario depends largely on facilities outside its borders to manage its biomedical waste.

The government of Ontario has developed a strategy for the management of biomedical waste in Ontario. In order to plan and implement this strategy, it is essential to have a detailed understanding of the rates of generation and distribution of biomedical waste in the province of Ontario.

Thus, to achieve full implementation, an accurate estimate of the quantities of biomedical waste produced in the province is needed. It is also important to understand whether or not generators have a clear understanding of the definition of biomedical waste. The second point is

very important so that the quantities of biomedical waste predicted truly reflect what generators will actually dispose of as biomedical waste.

The quantity estimates should be sufficiently specific and disaggregated so that they can be used to predict future trends in biomedical waste generation. They should also be divided by region within the province so that appropriate infrastructure planning can occur.

Reporting of "specific waste generation rates" (i.e. waste generation per activity) allows the data to be readily used to both predict regional biomedical waste generation rates, and to more accurately predict future quantities given information on changes in activity levels. This second point is only true if procedures do not change substantially.

All of these factors have been taken into account in designing and carrying out the study of biomedical waste generation in Ontario during the summer of 1992. The report sections that follow describe:

- the auditing procedures used to measure generation rates;
- the aggregation factors used to estimate regional and provincial totals of various waste categories;
- the audit results;
- post audit discussions of the definition of biomedical waste;
- conclusions and recommendations.

2. AUDITING PROCEDURE

The MOE's proposed definition of biomedical waste was used to define all categories of materials for auditing of the biomedical waste streams at the sites selected. Although more recent definitions have been proposed since the audit was undertaken, the changes are minor and have little or no impact on the audit findings.

This section describes the protocol used for sampling biomedical wastes from the selected sites, and includes a discussion of representative sample selection, auditing procedures, and health and safety precautions.

2.1 Selecting a Representative Sample

Biomedical wastes, like other waste streams, vary in quantity and composition with the type and level of activity used to generate them. Thus, in selecting specific sites to study for use as predictors of the entire Ontario biomedical waste stream, it is imperative that this variability in activity be taken into account. The sample sites chosen for this study deliberately include representatives of high and low quantity generators in each generator group (i.e. funeral home, medical laboratories, etc.). An attempt was also made to sample the variety of activities prevalent within each generator group (i.e. teaching hospitals vs general hospitals, or farm animal veterinarians vs pet veterinarians).

For all sites other than hospitals, the size of the representative biomedical waste stream sample (i.e. the number of days of generation

studied) was determined through conversation with appropriate site staff, including waste handling and waste generating individuals, as well as industry associations. The size of this sample, and the number of days or weeks of generation it represented, was such that all day to day variability normally present in the waste stream of generating departments at a site, in terms of waste types and quantities produced, was covered. For example, if a site reported that its waste stream was consistent in quantity and composition every day, except for one department operating only on Tuesday, then this site was audited for two consecutive days (including Tuesday).

2.1.1 Hospitals

Participant Selection

Hospitals to be audited were selected in conjunction with the Ministry of the Environment, Ministry of Health and Ontario Hospital Association. This group indicated that hospital biomedical waste quantities and composition may vary according to the size of hospital facility (i.e. provided by number of beds in small (0-199 beds), medium (200-399 beds) and large (400+ beds) facilities) and whether the hospital in question was a teaching, general care, chronic care or mental health facility. Thus, hospital participants were selected to represent large teaching, large, medium and small general care facilities, chronic care, and mental health facilities.

Waste Sampling

Biomedical waste containers were labelled to identify departments. The departments were identified and aggregated into one of the following categories, which are described fully in Appendix 2:

Patient Care
Patient Services
Laboratories
Support/Administration

Hospital waste varies little in composition over a week with the exception of emergency rooms and facilities such as operating rooms that schedule certain procedures for certain days of the week. Hospital participants in this study confirmed this. However, generation rates do vary, particularly at week-ends. Therefore, the biomedical waste audits were carried out over a one week period to capture both procedural variabilities on a day-to-day basis in operating rooms and other areas where scheduling is done, and regular daily variabilities in composition and quantities generated as a result of patients seen and treatments provided.

The only exception to this methodology was for several of the hospital sites which generated very small quantities of biomedical wastes on a daily basis. For these facilities, the audit team studied a one month, instead of a one week sample in order to ensure a large enough quantity of waste was sorted to provide reliable audit results.

2.1.2 Doctors' Offices

Participant Selection

The Ontario Medical Association provided volunteer doctors' offices to participate in the study. The majority of doctors' offices in Ontario offer general practitioners' services, while the rest specialize in various areas. Thus, three general practitioners' offices and one obstetrician/ gynecologist's office were selected for the study.

Waste Sampling

All doctors' offices indicated that it takes several weeks to completely fill a biomedical waste box or sharps container. These containers are typically used until they are filled and then are stored for collection and disposal services. ORTECH scheduled audits for these sites three to four weeks in advance so that materials could be generated for study. Sites' staff were asked to estimate the date that all filled containers (i.e. sharps and biomedical waste) were set out for collection in order for audit staff to ascertain the time period taken to generate the quantities measured.

2.1.3 Dentists' Offices

Participant Selection

Dentists' offices to be audited were selected by the Ontario Dental Association. The majority of dentists practising in the province offer

general dentistry services, while the remainder offer specialties such as dental surgery, etc. Thus, four general dentistry offices and one dental surgery office were audited for the study.

Waste Sampling

Similar to doctors, sites were asked to collect wastes in preparation for the audit in order to provide filled biomedical waste containers for sorting. The length of time (in weeks) for which waste was collected varied depending on the quantities generated at individual sites.

2.1.4 Veterinarians' Clinics

Participant Selection

The Ontario Veterinarian Medical Association (OVMA) provided contact names for sites to be audited. These sites included volunteers involved in treating pets, and those treating larger species and farm animals. By selecting sites conducting both types of practices, the OVMA felt that a more representative sample of the provincial biomedical waste stream generated by veterinarians would be attained.

Waste Sampling

In initial conversations with several of the participating veterinarians, it was indicated that the biomedical waste generation was small and primarily consisted of sharps. Similar to doctors and dentists, the audit teams conducted audits on waste collected over two-week to four-week

periods. These larger sample sizes allowed for more reliable samples of generator information.

2.1.5 Funeral Homes

Participant Selection

Funeral homes to be audited were selected by the Ontario Funeral Services Association. This association indicated that variability in biomedical waste generation by funeral homes in Ontario was dependent on the size of facility in terms of the number of cases processed. Thus, participants were selected to cover the range of large, medium and small facilities, with the intention that these representatives would provide a reliable indicator of average facility generation in the province.

Waste Sampling

On interviewing staff at these sites prior to auditing, it was determined that biomedical waste quantities generated were relatively small from funeral homes. Thus, similar to rates discussed earlier, audit teams sorted waste collected over a generation period from between two weeks and four weeks, ensuring greater reliability in the final sample.

2.1.6 Medical Laboratories

Participant Selection

Medical labs to be audited were selected by the Ontario Association of Medical Laboratories. This association indicated that biomedical waste generation characteristics varied according to the size of laboratory. Thus, the three laboratories selected ranged in volume throughput (i.e. on a number of services provided) from 10,000 (small laboratory) to 24,500 (large laboratory) services provided per day. Thus, one small, one medium and one large laboratory were sampled.

Waste Sampling

Preliminary meetings with laboratory staff indicated that waste composition in each facility to be studied varied over a 24-hour cycle. In other types of sites, it may be sufficient to sample one seventh of this 24-hour waste stream. However, due to the large variety of procedures carried out in these medical laboratories, such a study design would potentially miss key generating areas. Thus, all waste generated over the 24-hour study period was weighed and sorted.

Although waste was always consistent over a 24-hour period, one of the labs studied included areas which generated a full box of biomedical waste every two days. It was determined that this laboratory should be sampled over a 48-hour, instead of a 24-hour period. For this laboratory, all waste was weighed and sorted for a 48-hour period.

2.1.7 Other Laboratories

Participant Selection

Other types of laboratories operate in the province and generate biomedical wastes. These include government laboratories, university research facilities related to medical studies, veterinary research and teaching facilities and privately owned research laboratories. Representatives from each of these types of facilities were identified with input from the Ministry of Environment. The university research laboratory selected for study was considered typical of other similar facilities in the province, and the veterinary research and teaching facility was the only one of its kind in the province. However, typical facilities could not be selected for the private research and government laboratory categories. Each of these two groups is comprised of members who conduct research and analyses activities specific to their sites only. Thus, for each of these two types of sites, one relatively large quantity generator of biomedical waste was chosen for study.

Waste Sampling

In discussing biomedical waste generation, laboratory representatives indicated that the waste was generally consistent in daily composition but varied in quantity over time. Therefore, audits were conducted for a one week period to maximize the amount of waste available for sorting and to increase data reliability.

However, in most of these other laboratories, this one week audit had to be altered to suit the specific site. One very large generator indicated that, due to the potential hazard of the wastes generated, and facility health and safety policies, sorting of biomedical waste would not be possible. In this facility, the site staff indicated that they would prefer to choose two "generic" areas for study (one production and one research area) that would be representative of overall facility biomedical waste composition. After auditing these areas, sites' staff provided annual waste disposal data from the entire facility for comparison.

In another facility which autoclaved all waste prior to disposal, sorting was not possible. In this case, a sample size determined to be representative of "normal" generation (24-hour sample) was weighed, and laboratory staff were interviewed with regard to materials placed in biomedical waste containers.

Where the facility generated only animal carcasses and associated materials, yearly disposal records for on-site incinerator use (i.e. quantities and categories of materials incinerated) were obtained for the study. Where specific records of quantities were not available, estimates were provided by sites' staff.

2.1.8 Coroners' Offices

Participant Selection

The coroner's office has a number of regional facilities across the province. The Toronto facility, representing the largest in the province,

was selected to be audited since it has its own facilities and generates large quantities of biomedical wastes, including large proportions of anatomical and microbiological wastes. Other coroners' offices throughout the province perform autopsies in local hospitals and this waste is captured in the hospital data.

Waste Sampling

Site's staff indicated that the waste generated in this facility is relatively small in quantity considering the type of work performed. The reason for this is that organs and tissues removed, which are not required for further laboratory analysis, are replaced into the body cavity.

The site's staff indicated that waste generation and composition was fairly consistent from day to day. Thus, a one week sample would have been adequate for study. However, at the time of the audit, waste representing four weeks of generation was available for study. It is usual that, if a partially filled box is generated at the end of one week, it will be filled the next. Thus, it is difficult to separate out a quantity of waste which represents exactly one week of waste generation from a larger batch. For this reason, the entire quantity available, representing four weeks of generation, was studied.

2.1.9 Other Facilities

Many other types of facilities may generate small quantities of biomedical wastes, such as public schools, in-home diabetics, etc. Those expected to be most significant generators in this group were identified for study,

and included the Canadian Red Cross Blood Bank operations, nursing homes, pharmacies, pharmaceutical manufacturers, and in-home nursing care providers. The Canadian Red Cross Blood Bank operations and a nursing home were audited physically, while others were telephoned (pharmacies and pharmaceutical manufacturers). In-home nursing care providers were telephoned and briefed on the study, faxed a list of questions and then followed up via telephone.

Nursing Homes

With the assistance of the Ontario Nursing Home Association, one nursing home was identified for participation in the study. The materials identified for study included sharps and pharmaceuticals.

Pharmacies

With the assistance of the Ontario Pharmacists Association, twenty-five pharmacies in the Guelph/Cambridge area were identified, telephoned and surveyed as to their annual generation of waste pharmaceuticals (i.e. disposed at store locations) and sharps (i.e. from patient return-to-pharmacy programs). Fifteen of these pharmacies responded.

Pharmaceutical Manufacturers

With the assistance of the Pharmaceutical Manufacturers Association of Canada (PMAC), six large manufacturing companies were identified for telephone surveying. These firms were asked specifically for annual

data on animal carcasses, pharmaceuticals, microbiologicals and sharps disposed of via incineration. Four companies responded.

In-Home Nursing Care Providers

The provision of in-home health care services can potentially result in the disposal of biomedical wastes (i.e. sharps, blood soaked bandages) in residential garbage. Through conversations with in-home care providers in Ontario, it was determined that the majority of supplies (i.e. needles, bandages, etc.) used by this group was purchased by MOH regional offices and distributed to private care companies. The remainder is purchased by private firms such as Head Office Reference Laboratories (HORL).

Information collected via the method described above included lists of items purchased for the provision of in-home care. Sample weights of various sizes of syringe/needle combinations were measured in order to convert these data into weights for provincial extrapolation. Blood soaked bandages were not considered by regional offices to be a significant proportion of the in-home waste stream. Since these materials are disposed of at the generator site and are produced on an irregular basis, they are difficult to quantify. HORL waste quantities were also collected via telephone.

2.2 Auditing Procedures

Waste auditing is an involved process, beginning with pre-audit preparation to ensure that all waste is labelled as to its area of

generation and is transported to a central area for weighing and sorting. Then, the weighing and sorting protocol needs to be prepared, specifying how wastes will be managed for the study, which material categories will not be physically sorted, and health and safety precautions necessary for staff. The last step is the actual preparation of an audit area, and actual weighing and sorting of waste materials at specific sites chosen for study. All procedures described in this section were agreed upon in consultation with the MOE. All wastes studied in this project were categorized according to the materials described in MOE's proposed new definition of biomedical waste discussed earlier, as follows:

Biomedical Waste (as per MOE definition)
Human Anatomical Waste
Animal Waste
Microbiological Waste
Liquid Blood Waste
Blood Contaminated Biomedical Waste
Other Body Fluids Waste
Sharps Waste
Biomedical Sub Total

Pharmaceutical Waste
Non-Biomedical Animal Carcass Waste

***Contiguous Waste**
Blood Contaminated Non-Biomedical Waste
Contiguous Waste Sub Total

Non-Biomedical Waste

Total Currently disposed of as Biomedical Waste

*Contiguous wastes is a designation applying to all materials contaminated with blood but not to the degree of being considered biomedical wastes. Although these materials are not biomedical, there is a chance they may be mistaken for biomedical and disposed of accordingly.

2.2.1 Pre-Audit Meetings

Pre-audit meetings took place at all sites studied. The audit team met site staff responsible for managing and generating waste, and site infection control staff (in the case of hospitals). Issues which were discussed included:

a) Which, and how many departments were generating biomedical wastes. These were marked on a floor plan, where possible, and grouped according to the broad department categories (e.g. patient care, patient service, laboratories and administration for hospital sites).

b) The current procedures for treating and handling biomedical wastes (i.e. incineration, autoclaving, disinfection on site followed by landfill disposal) - knowledge of this information ensured that the entire waste stream was captured during the study.

c) The variability of the biomedical waste stream (quantity and composition) - this information helped to establish the duration of audit required to understand the biomedical waste stream generated at each site.

d) The frequency of biomedical waste collection from the various departments, and by the contracted waste hauler.

e) The internal site biomedical waste collection staff assigned to each department, their routes and schedules (i.e. how does the collection system work?).

f) Activities conducted in facility (i.e. research, etc.).

g) An appropriate room available for sorting and weighing waste - this room required good ventilation, washable floors, and security. It was also requested that the room be away from busy traffic areas.

The waste handling and collection staff were informed of the programme and the requirements for labelling the department of origin on all biomedical wastes for the duration of the study. Labels were provided to each biomedical waste staff member for this purpose. This practice applied specifically to hospitals.

2.2.2 Waste Audit Procedure

The waste audit process included site preparation and the actual audit.

Site Preparation

The audit team used either large tables or constructed sorting tables using sawhorses and plywood sheets for auditing wastes. These sorting tables were covered in protective plastic sheeting which was disposed of at the conclusion of the audit.

All sorting equipment, trays and baskets, as well as the audit teams' boots and rubber gloves were cleaned prior to each audit.
Other materials kept available included mops and pails, disinfectant sprays, and room deodorizers.

Waste Sorting Protocol

All biomedical waste containers were weighed and identified. If containers were not labelled, site staff were asked to identify the origin of the container. In some instances, where site staff were unable to identify unknowns, the audit team recorded information as 'unknown in origin'.

The boxes and/or bags to be sorted were opened and the contents carefully removed to minimize any aerosol generation. The bags were placed flat on the sorting table and cut open using a sharp, retractable knife.

The contents of the bag were sorted onto trays or into baskets for each of the defined waste categories listed in Section 2.2. Care was taken to minimize contact through splashing on the skin, and aerosols. The audit teams used tongs and poking rods to minimize physical contact with the biomedical waste.

After the waste had been sorted, the material was placed in a plastic tray and weighed. The weight of each basket or tray used was subtracted from the total weight (i.e. of tray and contents) and the data entered onto a table. The data were later entered into a computer spreadsheet for analysis by the audit team.

All waste disposed as biomedical was double bagged and placed back into the biomedical waste container. The waste was then disposed of through the sites' biomedical waste disposal system. The sorting equipment and weigh scale were washed down with disinfectant soap at the end of each day.

2.3 Health and Safety Precautions

Health and safety precautions designed to protect waste sorting staff are required for all audits. When the waste stream being studied is biomedical, and has the potential of containing active pathogens, these

precautions become doubly important. During the course of this study, waste audit staff were required to open and sort boxes of biomedical wastes which had been stored for one day to several weeks. Some of these boxes also contained microbiologicals which were not autoclaved prior to disposal. Thus, a protocol for using protective gear and sorting specific material categories was required.

It is important to note that these wastes do not normally present management difficulties to those who generate and handle them and understand the dangers and safety precautions necessary. However, they do present a potential hazard to outsiders who are not able to immediately recognize them and determine how and why they were produced.

The following section describes both protective gear used by sorting staff for each audit and the auditing protocol for special circumstances (i.e. special wastes).

2.3.1 Protective Gear

Protective gear to be worn by sorting staff for all audits included the following:

- Tyvek suit with hood and foot covers
- Heavy duty rubber boots
- Latex gloves under heavy duty rubber gloves
- Surgical or full face respirator type facial masks and goggles
- Rigid plastic facial shield

In order to avoid cuts or pricks by sharps, or contamination of skin by biohazards, all materials were sorted using tongs and metal pushing sticks. Sorters touched nothing with their gloved hands unless: (1) the item was fully visible and it was clear that it was not a sharp; and, (2) it was not possible to sort the item into the categories described through the use of tongs and pushing sticks only.

All floors, boots, goggles, rigid facial masks, tongs, etc., were washed down with bleach solution at the end of each day. All protective clothing was removed before sorting staff exited from the sorting area. This procedure avoided contaminants being moved out of the sorting area on equipment.

2.3.2 Special Precautions and Modified Waste Sorting Procedure

The audit team sorted the waste into the waste categories provided in Section 2.2. In some cases, the waste sorting procedure was modified but the material categories remained the same. Individual waste containers labelled or identifiable as sharps, Risk Group 3 and 4 (defined below), animal or human anatomical, cytotoxic (defined below), or autoclaved material (defined below), were handled in a different manner.

- **Sharps**

Sharps containers were presumed to contain only sharps, with minimal non-sharps items such as paper towels, syringe sheaths and syringes. Many sharps containers found in the study contained needles with syringes attached. The minimal contamination, as well as the potential

health risks to the sorting team, resulted in the decision not to sort sharps containers and rather assume that all contents were sharps according to the new MOE definition.

- **Biosafety 3 and 4 Wastes**

The U.S. Department of Health and Human Services categorizes infectious agents into 4 biosafety levels, where Group 1 includes lowest risk agents and Group 4 includes agents presenting the highest risk to human health. Biomedical waste generated from Level 3 and Level 4 facilities was handled in a different manner. For hospital sites and labs, the audit team consulted with the infection control practitioner to determine the potential risks involved in sorting such waste. Based on preliminary discussions with several infection control staff, these wastes are generated in only a few areas of hospital and lab facilities. Infection control staff from these sites recommended that the audit team assume all waste in the biomedical waste containers was, in fact, biomedical. In these circumstances, the audit team weighed and recorded the container and considered it biomedical.

Where equipment for the safe sorting of these materials (i.e. laminar flow fume hoods) and the site infection control practitioners permitted, the audit team sorted these wastes. This sorting was possible at one site only, where infection control staff were uncomfortable with ORTECH staff auditing microbiologicals from level 3 labs and thus chose two 'generic' labs where supervised sorting in specialized facilities was permitted.

A description of these levels is reproduced below from Biosafety in Microbiological and Biomedical Laboratories.

'**Biosafety Levels.** Four biosafety levels are described which consist of combinations of laboratory practices and techniques, safety equipment, and laboratory facilities appropriate for the operations performed and the hazard posed by the infectious agents and for the laboratory function or activity.

'**Biosafety Level 1** practices, safety equipment and facilities are appropriate for undergraduate and secondary educational training and teaching laboratories and for other facilities in which work is done with defined and characterized strains of viable microorganisms not known to cause disease in healthy adult humans. *Bacilus subtilis Naeglena gruben* and infectious canine hepatitis virus are representative of those microorganisms meeting these criteria. Many agents not ordinarily associated with disease processes in humans are, however, opportunistic pathogens and may cause infection in the young, the aged, and in immunodeficient or immunosuppressed individuals. Vaccine strains which have undergone multiple in vivo passages should not be considered avirulent simply because they are vaccine strains.

'**Biosafety Level 2** practices, equipment, and facilities are applicable to clinical, diagnostic, teaching and other facilities in which work is done with the broad spectrum of indigenous moderate-risk agents present in the community and associated with human disease of varying severity. With good microbiological techniques, these agents can be used safely in activities conducted in the open bench, provided the potential for

producing aerosols is low. Hepatitis B virus, the salmonellae, and *Toxoplasma* spp. are representative of microorganisms assigned to this containment level. Primary hazards to personnel working with these agents may include accidental autoincineration, ingestion, and skin or mucous membrane exposure to infectious materials. Procedures with high aerosol potential that may increase the risk of exposure of personnel must be conducted in primary containment equipment or devices.

'**Biosafety Level 3** practices, safety equipment, and facilities are applicable to clinical, diagnostic, teaching, research, or production facilities in which work is done with indigenous or exotic agents where the potential for infection by aerosols is real and the disease may have serious or lethal consequences. Autoincineration and ingestion also represent primary hazards to personnel working with these agents. Examples of such agents for which Biosafety Level 3 safeguards are generally recommended include *Mycobacterium tuberculosis*, St. Louis encephalitis virus, and *Coxiella burnetii.*

'**Biosafety Level 4** practices, safety equipment, and facilities are applicable to work with dangerous and exotic agents which pose a high individual risk of life-threatening disease. All manipulations of potentially infectious diagnostic materials, isolates, and naturally or experimentally infected animals pose a high risk of exposure and infection to laboratory personnel. Lassa fever virus is representative of the microorganisms assigned to Level 4.'

- **Animal and Human Anatomical Wastes**

In facilities generating animal and human anatomical wastes, the audit teams handled these wastes in a different manner. By law and hospital policy, all human anatomical waste is handled separately from other biomedical wastes. Human anatomical wastes usually go directly to the pathology department where they may be further examined. In handling a biomedical waste container originating from an area that may generate human anatomical or animal wastes, the audit team spoke with the department to determine the contents. Where the audit team was told the containers are entirely animal or human tissue, the wastes were weighed and entered into the appropriate category without further sorting.

Anatomical wastes are considered biomedical wastes under the new definition. However, some are typically disposed of differently from the rest of biomedical wastes, (e.g. placentae, which is utilized for recycling). Anatomical wastes handled in this way were not included in the quantification of wastes currently disposed of as "biomedical waste".

- **Cytotoxic Waste**

Cytotoxic wastes include materials which are hazardous and have a toxic effect on cells. The term 'cytotoxic' is commonly used to refer to pharmaceuticals used in treating cancer, e.g. antineoplasts and chemotherapy agents. Biomedical waste containers labelled or identified as coming from areas generating cytotoxic waste were considered to contain only biomedical waste for the purpose of sorting.

The reason for this was the inability to visually determine whether any given piece of material was contaminated with antineoplasts.

- **Liquid Blood Waste and Other Bodily Fluids**

Liquid blood and other bodily fluids required quantification as part of this study. However, these materials were often not made available for weighing and sorting as they were discharged directly to the sewer.

The majority of non-hospital sites dispose of these materials to the sewer as a usual procedure, and many hospitals also use this disposal method. The use of this disposal method is regulated by local municipal sewer use bylaws. For the purposes of quantifying liquid blood and bodily fluid wastes, ORTECH interviewed appropriate staff at sites discharging materials directly to the sewer. Appropriate individuals included nurses and housekeeping staff at hospitals and those identified by owners of separate facilities, etc.

- **Autoclaved Waste**

Autoclaving is a process utilized to treat microbiological wastes in most facilities. An autoclave is an apparatus which utilizes steam under pressure and is used typically for the sterilization of medical equipment and wastes with infectious properties. Some sites autoclave other materials as well, such as general wastes. Autoclaved material is often melted together, difficult to separate and hard to identify. Another difficulty facing audit teams is visually identifying whether a given piece

of material is contaminated with microbiological material. It was, therefore, assumed that any material autoclaved was biomedical.

2.3.3 Post Audit

All information collected through the waste audit procedure (i.e. weighing and sorting of biomedical wastes) procedure was tabulated on computer. Sites' staff were contacted for further information, such as statistical data on activity factors (i.e. number of samples processed or beds occupied, etc.) during the time period in which audited wastes were generated. These data were necessary for use in extrapolating biomedical waste results for the province. In addition, sites' staff were interviewed with respect to the results of their audits (i.e.questions and concerns with respect to the ease of implementation of the new biomedical waste definition). The questionnaire used for post audit follow-up is reproduced in Appendix 3. Using the questionnaire for each site ensured that questions asked of all participants were consistent.

3. METHODS OF DATA AGGREGATION

The approach taken in this study was to physically audit representative samples of generators of biomedical waste as discussed in Section 2 and reduce the data gathered to "Specific Generation Rates" based on "activity factors" which are chosen for each generator type. The selection of activity factors is based on two considerations:

- First, is the factor an appropriate one on which to aggregate data for that generator type?
- Second, is statistical data available on that activity factor that can be used to aggregate data to regional and provincial totals?

Activity factors are sometimes difficult to choose as they need to be relevant to aggregating waste generation, and statistics on them must be available. Although site staff participated in selecting their activity factors, many of these individuals are not accustomed to thinking about waste generation rate in relation to facility activities, or making selection of an appropriate factor difficult. For some facility types, such as the Office of the Chief Coroner of Ontario, the most appropriate activity factor was the number of autopsies conducted. For other facilities, such as hospitals, the choice was more difficult, e.g. number of procedures conducted, number of beds occupied and number of staff all might be appropriate. Number of occupied beds was chosen for hospitals because it is a most readily used factor for other hospitals to estimate their waste generation.

Other generator categories, such as dentists' or doctors' offices, include a variety of specialities such as surgery, general dentistry and orthodontics

for the former, and plastic surgery, gynecology, obstetrics, general medicine, etc., for the latter. These specialties generate different quantities and compositions of waste but for extrapolation purposes need to be expressed as an average (i.e. average generation rate for all dentists or doctors).

The final decision on the activity factor to be used depends on the availability of statistical data with which to extrapolate to obtain provincial estimates of generation. For a few generator types, such as veterinarians' offices, the activity factor we would have liked to use (i.e. number of treatments or number of veterinarians) could not be used because statistical information for the province was not available. In this case, numbers of veterinarians' offices was used as an activity factor because data on these were available.

Table 2 summarizes the activity factors chosen for the different types of biomedical waste generators surveyed. The rationale for the choices that have been made are discussed briefly in the sections that follow:

3.1 Hospitals

Hospitals are by far the largest single generator type for biomedical waste in Ontario. Approximately 67% of the waste currently disposed as biomedical comes from hospitals (results of this study, Tables 5-16). The decision for hospitals was to use "beds" as an activity factor on which to aggregate the data. To account for different activities occurring at different types of hospitals, the hospital sector was broken into six

TABLE 2 - Activity Factors for Different Generator Types, Used to Aggregate Sample Data for Regional and Provincial Total Generation Rates

	Activity Factors
Teaching Hospitals	occupied beds
Large Hospitals	occupied beds
Medium Hospitals	occupied beds
Small Hospitals	occupied beds
Psychiatric Hospitals	approved beds
Chronic Care Hospitals	occupied beds
Doctors	doctors
Dentists	dentists
Veterinarians	veterinarian clinics
Funeral Homes	funeral homes
Medical Laboratories	1,000 services
Coroners	1,000 autopsies
Other Laboratories	
University Medical Research	first year students
Veterinary Teaching/OMAF	stand alone, see Section 3.7(c)
Ministry of Health Laboratories	1,000 samples
Private Research/Biotechnology	stand alone, see Section 3.7(d)
Other:	
Nursing Homes	beds
Red Cross Blood Bank Operations	1,000 units of blood
Pharmacies	pharmacies
Pharmaceutical Manufacturers	stand alone, see Section 3.9.3
In-Home Health Care	*cases administered

*Data represent totals for province extrapolated from MOH supply information and HORL specimens.

different types of hospitals and appropriate audits were done on a sample of hospitals of each type. The six chosen hospital categories were:

Large Teaching Hospital
Large General Hospital, > 400 beds
Medium General Hospital, 200-399 beds
Small General Hospital, < 199 beds
Psychiatric Hospital
Chronic Care Hospital

These categories were chosen to reflect the fact that different health care services were likely to alter per bed generation rates and waste composition. For example, large general hospitals usually offer in-house laboratories and a much wider range of clinics and operating procedures than medium or small general hospitals, potentially resulting in generation of microbiologicals, day surgery wastes and blood/tissue wastes. Psychiatric and chronic care facilities offer much different activities than general hospitals, with the emphasis on nursing care and administration of medication. These activities potentially result in generation of sharps, pharmaceuticals and soiled bedding/clothing. Large teaching hospitals have strong research components to their activities not seen in other hospitals. Thus, the microbiological animal carcass and specimen generation may be greater.

These categories were also chosen because reliable statistical data[1], based on these classifications, (i.e. six hospital categories vs beds as an

[1]Ministry of Health Hospital Statistics 1989/90.

activity factor) exist to allow aggregation of data to regional and provincial totals, using numbers of beds as aggregation factors.

3.2 Doctors' Offices

Number of doctors was chosen as an activity factor for aggregation purposes. A variety of different types of practitioners were selected for the audit, including specialists and general practitioners, and averaged generation rates to a "per doctor" basis. Where several doctors operated within a clinic, the total waste generated in that clinic was summed and divided by the total number of doctors involved in all of the sites sampled to arrive at specific generation rates. It is important to recognize that this average was derived from a range of low (general practitioners) and high (plastic surgeons) generation rates.

The regional distribution of physicians was obtained from the Ontario Medical Association[2].

3.3 Dentists' Offices

Number of dentists was used as the activity factor for aggregating biomedical waste generation from dentists in a similar fashion to that used for doctors. As with data collected from doctors' offices, it is important to recognize that the average generation rate per dentist resulted from a range of low (general dentistry) and high (dental surgery) generation rates.

[2]Kathy Bugeja, The Ontario Medical Association Personal Communication 1992.

Regional distribution of dentists was obtained from the Ontario Dental Association.[3]

3.4 Veterinarians' Clinics

Number of veterinarians' practices or clinics was used as the activity factor for aggregation in the same way as doctors and dentists. Similar to these other practitioners, final averages for generation on a per clinic basis were derived from data collected at clinics specializing in treatment of pets and those specializing in larger animals. These specialties potentially result in different quantities of wastes and compositions varying with the types of cases handled. The majority of pet veterinarians is located in urban areas, while larger animal veterinarians are associated with farms and equestrian clubs located in rural areas.

Regional distribution of veterinarians' practices was obtained from the Office of the College of Veterinarians of Ontario.[4]

3.5 Funeral Homes

The Ontario Funeral Services Association assisted in choosing funeral homes for study which were representative of the various sizes existing in Ontario. This ensured that the funeral homes sampled were representative of the overall distribution of sizes of funeral homes in the province. The waste volumes measured were converted to yearly totals for each home sampled. These were then totalled and divided by the

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[3]Linda Samek, The Ontario Dental Association, Personal Communication, 1992.
[4] The Office of College Veterinarians of Ontario, Premise Listing Report, 1992.

number of homes sampled to arrive at specific generation rates in kg per year per funeral home. The activity factor of numbers of funeral homes rather than number of funerals was chosen because no data on regional distribution of funerals were available.

The regional distribution of funeral homes was computed from data supplied by the Ontario Board of Funeral Services.[5]

3.6 Medical Laboratories

The three medical laboratories selected for study represented small, medium and large labs in terms of the number of services provided and covered the full range of diagnostic services offered in Ontario by medical laboratories. The results from each of the lab audits were related to the number of samples processed during the time of the audit. The results were divided by the number of thousands of services provided during the time period represented by the audit to develop specific generation rate data in kg per 1,000 services. The regional distribution of numbers of thousands of services processed per year was computed from data provided by the Ministry of Health.[6]

3.7 Other Laboratories

Other laboratories, including the Ministry of Health, University Medical Research Facilities, Ontario Veterinary College/OMAF facility and a

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[5] Board of Funeral Services, Annual Directory, 1992.
[6] Marcia Ong, Ministry of Health, Personal Communication, 1992.

private research/biotechnology laboratory, were aggregated to provincial totals as follows:

a) Ministry of Health Laboratories

The largest Ministry of Health Laboratory, located in the Toronto area, was sampled. Although there are other regional facilities, each differs from this Toronto area facility in the range and specialty of services provided, and these differences are considered significant for the purposes of this study. Thus, the results from auditing the selected facility are presented as stand-alone information, without aggregation into provincial regional totals. Extrapolating these data to other MOH facilities would, according to sites' staff, result in inaccurate generation estimates. It was decided that these other facilities were not significant enough generators of biomedical waste in Ontario to require audits. Figures for the site audited were reduced to a specific generation rate based on kg/1,000 samples processed.

b) University Medical Research Facilities

There are 4 universities in Ontario with Medical Research Facilities.[7] It was decided that one of these sites would be audited and data extrapolated to describe biomedical waste generation from this type of facility. Data from the selected site were related to the number of first year students enrolled in the Medical Sciences program at this university.

[7] University of Toronto, Faculty of Medicine Admissions Office, 1992.

The regional distribution of waste generated by this type of site was calculated from information on the regional distribution of first year medical sciences students in the province This information was supplied by the individual university sites.[7]

c) Veterinary Teaching Facilities, Ontario Ministry of Agriculture and Food (OMAF) Diagnostic Laboratories

The Ontario Veterinary College (OVC) trains veterinarians, and utilizes an OMAF incineration and research facility. This site has been audited for the study via a survey of incinerator use data provided from use by both the OMAF facility and OVC in a combined format. OVC is the only facility of its kind. Thus, yearly incineration use data are presented as stand-alone data for the purposes of this report.

d) Private Research/Biotechnology Laboratory

There is a wide variety of activities conducted by private research and biotechnology labs in Ontario. In order to understand biomedical waste generation characteristics from this sector, several audits would need to be conducted. Since this was not possible, one very large volume generator in this sector was chosen for study. The facility sampled in this study conducts research which is specialized, and is not conducted elsewhere in the province. Thus, extrapolation of biomedical waste data collected to other private laboratories would not be appropriate. Data for this facility type are reported annualized without extrapolation to other facilities.

3.8 Coroners' Offices

Only one region (Central East) has a coroner's office that performs autopsies in a separate stand alone office. This facility could be considered a central facility for the province, dedicated to investigating deaths of a suspicious nature. Other coroners' offices in the province perform their autopsies at local hospitals. The results from the audit of this facility were related to the number of autopsies performed during the time over which the audit took place, and reduced to a specific generation rate based on kg/1,000 autopsies. The total number of autopsies performed per year by this office was then used to aggregate to a kg/year basis.

3.9 Other Facilities

3.9.1 Nursing Homes

As for hospitals, beds were chosen as an activity factor for nursing homes. Regional distribution of nursing home beds was computed from data provided by The Ontario Nursing Homes Association and Ministry of Health.[8,9]

3.9.2 Pharmacies

Data on biomedical waste and pharmaceutical waste generation rates were requested from a selection of pharmacies. An average generation

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8 Ontario Nursing Homes Association ,1992
9 Steve Patterson, Ministry of Health, Personal Communication, 1992.

rate per pharmacy per year was computed. The activity factor selected to aggregate these data to regional totals was pharmacies. It is important to recognize that this activity factor averages a range of very busy pharmacies, (i.e. those that fill large numbers of prescriptions) and pharmacies with small prescription businesses.

Regional distribution data for pharmacies were obtained from the Ontario Pharmacists Association (OPA).[10]

3.9.3 Pharmaceutical Manufacturers

The Ontario Pharmaceutical Manufacturers Association (OPMA) supplied contact names for six of their members whom they considered to be large manufacturers. These firms were contacted as to their Ontario manufacturing activities. The data collected from this process provided information suggesting that many manufacturers produced their products out-of-province, and used Ontario facilities as distribution locations only. It is unclear, and would require further research, to establish a list of firms that manufacture products and generate biomedical wastes in Ontario. As such, to avoid an incomplete or inaccurate extrapolation of data across the province, we have included the data collected for this sector as stand-alone information only. These data are presented for the MOH region in which the surveyed facilities are located.

[10] Ontario Pharmacists Association, 1992.

3.9.4 In-Home Nursing Care Providers

The majority of in-home health care services are provided in Ontario by agencies contracted by the Ministry of Health. The very small remainder is provided by agencies contracted by patients directly and by insurance and other private firms. The MOH provides its contractors with supplies (i.e. syringes, needles, bandages) which are ordered and dispensed through 38 Home Care program regional offices.[11]

Twenty-one out of 38 Home Care regional offices participated in the study by providing purchasing data for syringes/needles, etc. Data that were received were computed in kg of waste needles and syringe/needle combinations per case administered on an annual basis. Annual caseload information was obtained from most Home Care offices in Ontario, and their data were used to calculate extrapolated provincial data on an MOH regional basis.

HORL operates one central laboratory which receives the majority of insurance specimens, (i.e. specimens collected when individuals requesting life insurance are examined by a physician or nurse hired by the insurer). ORTECH telephoned this facility and asked for information on quantities of wastes disposed as biomedical on a yearly basis. This laboratory was also asked to estimate quantities generated of each of the categories listed in Section 2.2. Data collected from HORL were added to annual totals estimated from the MOH In-Home Health Care program.

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[11] Information provided by the Executive Director of each Ontario Home Care Program,1992.

3.9.5 Red Cross Blood Bank Operations

The number of units of blood processed per year was used as the activity factor for Red Cross Blood Bank operations. The data from the waste audit were related to the number of samples processed during the audit period, and the generation rates reported in kg/1,000 units of blood.

Information on the numbers of thousands of units of blood processed in 1991 throughout Ontario was supplied by the Red Cross.[12] These data were used to generate a regional distribution according to MOH defined regions.

[12] Judy Lewis, The Canadian Red Cross Society, Toronto Centre, 1992.

4. RESULTS

The results presented in this final report summarize all the data developed during the audit study. The data are presented in Tables 3-17. A brief description of these tables follows.

Table 3 summarizes waste generation activity factors for the province on a regionalized basis according to MOH's six planning regions. This Table also provides provincial totals for each of the activity factors. Activity factors were discussed earlier in Section 3, as was the rationale for choosing a specific activity factor for each type of facility studied. Table 3 can be utilized to determine, for example, that 42,617 nursing home beds are available in the province, or that there are 2,750 doctors practising in MOH's South West region. Information presented in this Table has been utilized as a basis for calculating provincial distribution of biomedical wastes. It can be seen from this Table that there are no teaching or large hospitals located in the North East and North West regions.

Table 4 functions as a final summary of data collected as a result of this study. The Table presents generation rates for all material categories currently disposed as biomedical (i.e. human anatomical, animal waste, etc.), for each of the 21 types of sites audited (i.e. teaching hospitals, funeral homes, etc.), based on the specific activity factors chosen in Section 3 (i.e. occupied beds, funeral homes, etc.). This Table can be utilized currently to determine that, for example, 29.75 kg/yr of microbiological waste was generated by the teaching hospitals audited for each bed occupied during the period covered by each audit. This

Table also has utility in the future, as it provides statistics which can be used to estimate provincial biomedical waste generation by material category as activity factors change.

Tables 5-16 are a series of 12 Tables, one for each of the categories of waste currently disposed as biomedical. Each Table provides total waste generated in the given category by MOH planning region and for the province as a whole, tabulated by facility type. These estimates were arrived at via Table 4, distribution of generators, and Table 5, generation rates. A summary line at the bottom of these Tables provides total waste generation in each category (i.e. human anatomical, etc.) by MOH planning region for all facility types. Thus, the Tables are as follows:

Table 5	Generation of Human Anatomical Waste
Table 6	Generation of Animal Waste
Table 7	Generation of Microbiological Waste
Table 8	Generation of Liquid Blood
Table 9	Generation of Blood Contaminated Biomedical
Table 10	Generation of Other Body Fluids
Table 11	Generation of Sharps
Table 12	Summary of Biomedical Waste Generation
Table 13	Generation of Blood Contaminated Non-Biomedical (Contiguous Wastes)
Table 14	Generation of Non-Biomedical Animal Carcasses
Table 15	Generation of Pharmaceuticals
Table 16	Generation of Non-Biomedical Waste currently disposed as Biomedical

Table 17 is a summary of Tables 5-16, which details the total quantities of each of the 11 categories of waste, by all generator types, generated in each of the six MOH regions, plus the total for Ontario. This Table was constructed by taking the TOTALS lines from Tables 5-16 and inserting them into the appropriate spot in Table 17.

Table 3 - Distribution of Generators

Facility	Factor	SW	CW	CE	E	NE	NW	Total
Teaching Hospitals	Occupied beds	1542	1959	3912	1998	0	0	9411
Large Hospitals	Occupied beds	1597	1181	6486	377	0	0	9641
Medium Hospitals	Occupied beds	1618	2701	3844	1480	1165	455	11263
Small Hospitals	Occupied beds	1503	1114	1568	1634	1678	671	8168
Psychiatric Hospitals	Approved beds	1068	502	1122	938	726	237	4593
Chronic Care Hospitals	Occupied beds	621	607	1555	1136	63	200	4182
Doctors	Doctors	2750	3496	9805	3602	875	344	20872
Dentists	Dentists	706	966	3152	697	275	121	5917
Vets	Vet Clinics	171	204	368	138	64	15	960
Funeral Homes	Funeral Homes	126	108	123	105	42	14	518
Medical Labs	1000 services	6490	7503	44336	7920	1957	729	68935
Coroners	1000 autopsies			1.3				1
University Medical Research	1st yr students	96	100	252	159			607
Veterinary Teaching/OMAF	*1							0
MOH	*1							0
Private Research/Biotech	*1							0
In Home Care	*2							0
Nursing Home	beds	7306	7955	16219	7014	3170	953	42617
Red Cross	1000 units blood	70.4	82.0	176.4	71.4	34.9	4.5	439.6
Pharmacies	pharmacies	310	415	937	310	191	46	2209
Pharmaceutical Manufacturer	*2							

*1 Unique facilities. Refer to appropriate section of report for further information
*2 Refer to appropriate section of report for further information

Table 4 - Generation Rates, kg/factor/year

Facility	Factors	Biomedical							Non-Biomed.	Contiguous	Animal	Pharma-	Total
		Human Anatomical	Animal Waste	Micro-biological	Liquid Blood	Blood Contam.	Other Body Fluids	Sharps		Blood Contam Non-Biomed	Carcasses	ceuticals	
Teaching Hospitals	Occupied bed	8.13	0.00	29.75	26.75	19.85	8.39	37.17	186.00	16.47	46.43	2.93	381.87
Large Hospitals	Occupied bed	1.08	0.00	9.92	10.19	34.76	4.92	24.03	164.68	10.76	0.00	0.56	260.9
Medium Hospitals	Occupied bed	7.52	0.00	17.55	15.57	31.98	10.19	20.33	99.04	4.36	0.00	7.74	214.28
Small Hospitals	Occupied bed	1.55	0.00	24.39	4.84	4.61	4.43	19.14	76.97	3.41	0.00	1.86	141.2
Psychiatric Hospitals	Approved bed	0.00	0.00	0.00	0.40	0.05	0.00	0.80	0.52	0.01	0.00	0.00	1.78
Chronic Care Hospitals	Occupied bed	0.00	0.00	0.00	0.00	0.28	0.00	2.63	7.76	0.76	0.00	0.00	11.43
Doctors	Doctor	0.00	0.00	0.00	0.00	0.00	0.00	24.50	0.00	0.00	0.00	0.00	24.5
Dentists	Dentist	0.00	0.00	0.00	0.00	0.62	0.00	11.64	0.51	0.37	0.00	0.00	13.14
Vets	Vet Clinics	0.00	2.40	0.00	0.00	1.10	0.00	54.39	4.03	2.61	883.93	1.19	949.65
Funeral Homes	Funeral Home	0.02	0.00	0.00	5.50	72.48	0.04	0.16	108.79	32.55	0.00	5.71	225.25
Medical Labs	1000 services	0.00	0.00	11.37	10.91	0.19	1.16	3.98	7.05	0.88	0.00	0.00	35.54
Coroners	1000 autopsies	0.61	0.00	1.90	237.81	302.44	0.00	0.25	470.28	0.00	5.64	0.54	1019.47
University Medical Research	1st yr students	0.00	0.00	31.45	0.00	0.00	0.00	98.51	0.00	0.00	46.84	0.00	176.8
Vet Teaching/ OMAF	*1												
MOH Labs	*1												
Private Research/Biotech	*1												
In Home Care	*2												
Nursing Homes	Approved bed	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.18	0.23
Red Cross	1000 units blood	0.00	0.00	0.00	70.79	10.74	0.00	17.09	10.10	0.59	0.00	0.00	109.31
Pharmacies	Pharmacy	0.00	0.00	0.00	0.00	0.00	0.00	2.82	0.00	0.00	0.00	6.67	9.49
Pharmaceutical Manufacturer	*2												

*1 Unique facilities. Refer to appropriate section of report for further information
*2 Refer to appropriate section of report for further information

Table 5 - Generation of Human Anatomical Waste, kg/year

	M.O.H. Region						Total
Facility	SW	CW	CE	E	NE	NW	Ontario
Teaching Hospitals	12536	15927	31805	16244	0	0	76511
Large Hospitals	1725	1275	7005	407	0	0	10412
Medium Hospitals	12167	20312	28907	11130	8761	3422	84698
Small Hospitals	2330	1727	2430	2533	2601	1040	12660
Psychiatric Hospitals	0	0	0	0	0	0	0
Chronic Care Hospitals	0	0	0	0	0	0	0
Doctors	0	0	0	0	0	0	0
Dentists	0	0	0	0	0	0	0
Vets	0	0	0	0	0	0	0
Funeral Homes	3	2	2	2	1	0	10
Medical Labs	0	0	0	0	0	0	0
Coroners	0	0	1	0	0	0	1
University Medical Research	0	0	0	0	0	0	0
Veterinary Teaching/OMAF	0	0	0	0	0	0	0
MOH Laboratory	0	0	0	0	0	0	0
Private Research/Biotech.	0	0	0	0	0	0	0
In Home Care	0	0	0	0	0	0	0
Nursing Home	0	0	0	0	0	0	0
Red Cross	0	0	0	0	0	0	0
Pharmacies	0	0	0	0	0	0	0
Pharmaceutical Manufacturer	0	0	0	0	0	0	0
Total	28761	39243	70150	30315	11363	4462	184293

Note: Slight deviations in totals may occur due to rounding.

Table 6 - Generation of Animal Waste, kg/year

Facility	M.O.H. Region						Total Ontario
	SW	CW	CE	E	NE	NW	
Teaching Hospitals	0	0	0	0	0	0	0
Large Hospitals	0	0	0	0	0	0	0
Medium Hospitals	0	0	0	0	0	0	0
Small Hospitals	0	0	0	0	0	0	0
Psychiatric Hospitals	0	0	0	0	0	0	0
Chronic Care Hospitals	0	0	0	0	0	0	0
Doctors	0	0	0	0	0	0	0
Dentists	0	0	0	0	0	0	0
Vets	410	490	883	331	154	36	2304
Funeral Homes	0	0	0	0	0	0	0
Medical Labs	0	0	0	0	0	0	0
Coroners	0	0	0	0	0	0	0
University Medical Research	0	0	0	0	0	0	0
Veterinary Teaching/OMAF	0	21000	0	0	0	0	21000
MOH Laboratory	0	0	7050	0	0	0	7050
Private Research/Biotech.	0	0	0	0	0	0	0
In Home Care	0	0	0	0	0	0	0
Nursing Home	0	0	0	0	0	0	0
Red Cross	0	0	0	0	0	0	0
Pharmacies	0	0	0	0	0	0	0
Pharmaceutical Manufacturer	0	0	0	0	0	0	0
Total	410	21490	7933	331	154	36	30354

Slight deviations in totals may occur due to rounding.

Table 7 - Generation of Microbiological Waste, kg/year

Facility	SW	CW	CE	E	NE	NW	Total Ontario
Teaching Hospitals	45875	58280	116382	59441	0	0	279977
Large Hospitals	15842	11716	64341	3740	0	0	95639
Medium Hospitals	28396	47403	67462	25974	20446	7985	197666
Small Hospitals	36658	27170	38244	39853	40926	16366	199218
Psychiatric Hospitals	0	0	0	0	0	0	0
Chronic Care Hospitals	0	0	0	0	0	0	0
Doctors	0	0	0	0	0	0	0
Dentists	0	0	0	0	0	0	0
Vets	0	0	0	0	0	0	0
Funeral Homes	0	0	0	0	0	0	0
Medical Labs	73791	85309	504100	90050	22251	8289	783791
Coroners	0	0	2	0	0	0	2
University Medical Research	3019	3145	7925	5001	0	0	19090
Veterinary Teaching/OMAF	0	200	0	0	0	0	200
MOH Laboratory	0	0	118148	0	0	0	118148
Private Research/Biotech.	0	0	23424	0	0	0	23424
In Home Care	0	0	0	0	0	0	0
Nursing Home	0	0	0	0	0	0	0
Red Cross	0	0	0	0	0	0	0
Pharmacies	0	0	0	0	0	0	0
Pharmaceutical Manufacturer	0	0	0	0	0	0	0
Total	203581	233223	940029	224059	83623	32640	1717155

Slight deviations in totals may occur due to rounding.

Table 8 - Generation of Liquid Blood, kg/year

Facility	M.O.H. Region						Total Ontario
	SW	CW	CE	E	NE	NW	
Teaching Hospitals	41249	52403	104646	53447	0	0	251744
Large Hospitals	16273	12034	66092	3842	0	0	98242
Medium Hospitals	25192	42055	59851	23044	18139	7084	175365
Small Hospitals	7275	5392	7589	7909	8122	3248	39533
Psychiatric Hospitals	427	201	449	375	290	95	1837
Chronic Care Hospitals	0	0	0	0	0	0	0
Doctors	0	0	0	0	0	0	0
Dentists	0	0	0	0	0	0	0
Vets	0	0	0	0	0	0	0
Funeral Homes	693	594	677	578	231	77	2849
Medical Labs	70806	81858	483706	86407	21351	7953	752081
Coroners	0	0	309	0	0	0	309
University Medical Research	0	0	0	0	0	0	0
Veterinary Teaching/OMAF	0	0	0	0	0	0	0
MOH Laboratory	0	0	0	0	0	0	0
Private Research/Biotech.	0	0	0	0	0	0	0
In Home Care	0	0	35455	0	0	0	35455
Nursing Home	0	0	0	0	0	0	0
Red Cross	4984	5805	12487	5054	2471	319	31119
Pharmacies	0	0	0	0	0	0	0
Pharmaceutical Manufacturer	0	0	0	0	0	0	0
Total	166898	200341	771261	180655	50603	18776	1388534

Slight deviations in totals may occur due to rounding.

Table 9 - Generation of Blood Contaminated Biomedical, kg/year

Facility	M.O.H. Region						Total Ontario
	SW	CW	CE	E	NE	NW	
Teaching Hospitals	30609	38886	77653	39660	0	0	186808
Large Hospitals	55512	41052	225453	13105	0	0	335121
Medium Hospitals	51744	86378	122931	47330	37257	14551	360191
Small Hospitals	6929	5136	7228	7533	7736	3093	37654
Psychiatric Hospitals	53	25	56	47	36	12	230
Chronic Care Hospitals	174	170	435	318	18	56	1171
Doctors	0	0	0	0	0	0	0
Dentists	438	599	1954	432	171	75	3669
Vets	188	224	405	152	70	17	1056
Funeral Homes	9132	7828	8915	7610	3044	1015	37545
Medical Labs	1233	1426	8424	1505	372	139	13098
Coroners	0	0	393	0	0	0	393
University Medical Research	0	0	0	0	0	0	0
Veterinary Teaching/OMAF	0	0	0	0	0	0	0
MOH Laboratory	0	0	0	0	0	0	0
Private Research/Biotech.	0	0	0	0	0	0	0
In Home Care *	0	0	0	0	0	0	0
Nursing Home	0	0	0	0	0	0	0
Red Cross	756	881	1895	767	375	48	4721
Pharmacies	0	0	0	0	0	0	0
Pharmaceutical Manufacturer	0	0	0	0	0	0	0
Total	156768	182604	455743	118459	49078	19005	981657

* - Not Accounted For

Slight deviations in totals may occur due to rounding.

Table 10 - Generation of Other Body Fluids, kg/year

	M.O.H. Region						
Facility	SW	CW	CE	E	NE	NW	Total
Teaching Hospitals	12937	16436	32822	16763	0	0	78958
Large Hospitals	7857	5811	31911	1855	0	0	47434
Medium Hospitals	16487	27523	39170	15081	11871	4636	114770
Small Hospitals	6658	4935	6946	7239	7434	2973	36184
Psychiatric Hospitals	0	0	0	0	0	0	0
Chronic Care Hospitals	0	0	0	0	0	0	0
Doctors	0	0	0	0	0	0	0
Dentists	0	0	0	0	0	0	0
Vets	0	0	0	0	0	0	0
Funeral Homes	5	4	5	4	2	1	21
Medical Labs	7528	8703	51430	9187	2270	846	79965
Coroners	0	0	0	0	0	0	0
University Medical Research	0	0	0	0	0	0	0
Veterinary Teaching/OMAF	0	0	0	0	0	0	0
MOH Laboratory	0	0	0	0	0	0	0
Private Research/Biotech.	0	0	23956	0	0	0	23956
In Home Care	0	0	0	0	0	0	0
Nursing Home	0	0	0	0	0	0	0
Red Cross	0	0	0	0	0	0	0
Pharmacies	0	0	0	0	0	0	0
Pharmaceutical Manufacturer	0	0	0	0	0	0	0
Total	51474	63413	186240	50129	21577	8455	381288

Slight deviations in totals may occur due to rounding.

Table 11 - Generation of Sharps, kg/year

Facility	M.O.H. Region						Total Ontario
	SW	CW	CE	E	NE	NW	
Teaching Hospitals	57316	72816	145409	74266	0	0	349807
Large Hospitals	38376	28379	155859	9059	0	0	231673
Medium Hospitals	32894	54911	78149	30088	23684	9250	228977
Small Hospitals	28767	21322	30012	31275	32117	12843	156336
Psychiatric Hospitals	854	402	898	750	581	190	3674
Chronic Care Hospitals	1633	1596	4090	2988	166	526	10999
Doctors	67375	85652	240223	88249	21438	8428	511364
Dentists	8218	11244	36689	8113	3201	1408	68874
Vets	9301	11096	20016	7506	3481	816	52214
Funeral Homes	20	17	20	17	7	2	83
Medical Labs	25830	29862	176457	31522	7789	2901	274361
Coroners	0	0	0	0	0	0	0
University Medical Research	9457	9851	24825	15663	0	0	59796
Veterinary Teaching/OMAF	0	120	0	0	0	0	120
MOH Laboratory	0	0	0	0	0	0	0
Private Research/Biotech.	0	0	0	0	0	0	0
In Home Care	395	515	604	754	271	72	2611
Nursing Home	365	398	811	351	159	48	2131
Red Cross	1203	1401	3015	1220	596	77	7513
Pharmacies	874	1170	2642	874	539	130	6229
Pharmaceutical Manufacturer	0	0	0	0	0	0	0
Total	282879	330754	919716	302695	94027	36691	1966762

Slight deviations in totals may occur due to rounding.

Table 12 - Summary of Biomedical Waste Generation (kg/year)

	M.O.H. Region						Total
Facility	SW	CW	CE	E	NE	NW	Ontario
Teaching Hospitals	200522	254748	508716	259820	0	0	1223806
Large Hospitals	135585	100267	550661	32007	0	0	818521
Medium Hospitals	166881	278581	396470	152647	120158	46929	1161666
Small Hospitals	88617	65681	92449	96341	98935	39562	481585
Psychiatric Hospitals	1335	628	1403	1173	908	296	5741
Chronic Care Hospitals	1807	1766	4525	3306	183	582	12170
Doctors	67375	85652	240223	88249	21438	8428	511364
Dentists	8656	11843	38644	8545	3372	1483	72542
Vets	9899	11810	21304	7989	3705	868	55574
Funeral Homes	9853	8446	9619	8211	3284	1095	40508
Medical Labs	179189	207158	1224117	218671	54033	20128	1903295
Coroners	0	0	706	0	0	0	706
University Medical Research	12476	12996	32750	20664	0	0	78886
Veterinary Teaching/OMAF	0	21320	0	0	0	0	21320
MOH Laboratory	0	0	125198	0	0	0	125198
Private Research/Biotech.	0	0	47380	0	0	0	47380
In Home Care	395	515	36059	754	271	72	38066
Nursing Home	365	398	811	351	159	48	2131
Red Cross	6943	8087	17397	7041	3442	444	43354
Pharmacies	874	1170	2642	874	539	130	6229
Pharmaceutical Manufacturer	0	0	0	0	0	0	0
Total	890771	1071066	3351072	906643	310424	120065	6650042

Slight deviations in totals may occur due to rounding.

Table 13 - Generation of Blood Contaminated Non-Biomedical (Contiguous Wastes), kg/year

Facility	M.O.H. Region						Total Ontario
	SW	CW	CE	E	NE	NW	
Teaching Hospitals	25397	32265	64431	32907	0	0	154999
Large Hospitals	17184	12708	69789	4057	0	0	103737
Medium Hospitals	7054	11776	16760	6453	5079	1984	49107
Small Hospitals	5125	3799	5347	5572	5722	2288	27853
Psychiatric Hospitals	11	5	11	9	7	2	46
Chronic Care Hospitals	472	461	1182	863	48	152	3178
Doctors	0	0	0	0	0	0	0
Dentists	261	357	1166	258	102	45	2189
Vets	446	532	960	360	167	39	2506
Funeral Homes	4101	3515	4004	3418	1367	456	16861
Medical Labs	5711	6603	39016	6970	1722	642	60663
Coroners	0	0	0	0	0	0	0
University Medical Research	0	0	0	0	0	0	0
Veterinary Teaching/OMAF	0	0	0	0	0	0	0
MOH Laboratory	0	0	0	0	0	0	0
Private Research/Biotech.	0	0	0	0	0	0	0
In Home Care	0	0	0	0	0	0	0
Nursing Home	0	0	0	0	0	0	0
Red Cross	42	48	104	42	21	3	259
Pharmacies	0	0	0	0	0	0	0
Pharmaceutical Manufacturer	0	0	0	0	0	0	0
Total	65804	72070	202770	60909	14235	5610	421398

Slight deviations in totals may occur due to rounding.

Table 14 - Generation of Non-Biomedical Animal Carcasses, kg/year

	M.O.H. Region						Total
Facility	SW	CW	CE	E	NE	NW	Ontario
Teaching Hospitals	71595	90956	181634	92767	0	0	436953
Large Hospitals	0	0	0	0	0	0	0
Medium Hospitals	0	0	0	0	0	0	0
Small Hospitals	0	0	0	0	0	0	0
Psychiatric Hospitals	0	0	0	0	0	0	0
Chronic Care Hospitals	0	0	0	0	0	0	0
Doctors	0	0	0	0	0	0	0
Dentists	0	0	0	0	0	0	0
Vets	151152	180322	325286	121982	56572	13259	848573
Funeral Homes	0	0	0	0	0	0	0
Medical Labs	0	0	0	0	0	0	0
Coroners	0	0	7	0	0	0	7
University Medical Research	4497	4684	11804	7448	0	0	28432
Veterinary Teaching/OMAF	0	215800	0	0	0	0	215800
MOH Laboratory	0	0	0	0	0	0	0
Private Research/Biotech.	0	0	0	0	0	0	0
In Home Care	0	0	0	0	0	0	0
Nursing Home	0	0	0	0	0	0	0
Red Cross	0	0	0	0	0	0	0
Pharmacies	0	0	0	0	0	0	0
Pharmaceutical Manufacturer	0	0	0	0	0	0	0
Total	227244	491762	518731	222197	56572	13259	1529765

Slight deviations in totals may occur due to rounding.

Table 15 - Generation of Pharmaceuticals, kg/year

	M.O.H. Region						Total
Facility	SW	CW	CE	E	NE	NW	Ontario
Teaching Hospitals	4518	5740	11462	5854	0	0	27574
Large Hospitals	894	661	3632	211	0	0	5399
Medium Hospitals	12523	20906	29753	11455	9017	3522	87176
Small Hospitals	2796	2072	2916	3039	3121	1248	15192
Psychiatric Hospitals	0	0	0	0	0	0	0
Chronic Care Hospitals	0	0	0	0	0	0	0
Doctors	0	0	0	0	0	0	0
Dentists	0	0	0	0	0	0	0
Vets	203	243	438	164	76	18	1142
Funeral Homes	719	617	702	600	240	80	2958
Medical Labs	0	0	0	0	0	0	0
Coroners	0	0	1	0	0	0	1
University Medical Research	0	0	0	0	0	0	0
Veterinary Teaching/OMAF	0	200	0	0	0	0	200
MOH Laboratory	0	0	0	0	0	0	0
Private Research/Biotech.	0	0	0	0	0	0	0
In Home Care *	0	0	0	0	0	0	0
Nursing Home	1315	1432	2919	1263	571	172	7671
Red Cross	0	0	0	0	0	0	0
Pharmacies	2068	2768	6250	2068	1274	307	14734
Pharmaceutical Manufacturer	0	0	102500	0	0	0	102500
Total	25037	34638	160574	24654	14299	5346	264547

* - Not Accounted For

Slight deviations in totals may occur due to rounding.

Table 16 - Summary of Non-Biomedical Waste Generation Disposed as Biomedical Waste, kg/year

Facility	M.O.H. Region						Total Ontario
	SW	CW	CE	E	NE	NW	
Teaching Hospitals	286812	364374	727632	371628	0	0	1750446
Large Hospitals	262994	194487	1068114	62084	0	0	1587680
Medium Hospitals	160247	267507	380710	146579	115382	45063	1115488
Small Hospitals	115686	85745	120689	125769	129156	51647	628691
Psychiatric Hospitals	555	261	583	488	378	123	2388
Chronic Care Hospitals	4819	4710	12067	8815	489	1552	32452
Doctors	0	0	0	0	0	0	0
Dentists	360	493	1608	355	140	62	3018
Vets	689	822	1483	556	258	60	3869
Funeral Homes	13708	11749	13381	11423	4569	1523	56353
Medical Labs	45755	52896	312569	55836	13797	5139	485992
Coroners	0	0	611	0	0	0	611
University Medical Research	0	19154	0	0	0	0	19154
Veterinary Teaching/OMAF	0	0	0	0	0	0	0
MOH Laboratory	0	0	0	0	0	0	0
Private Research/Biotech.	0	0	0	0	0	0	0
In Home Care	0	0	0	0	0	0	0
Nursing Home	0	0	0	0	0	0	0
Red Cross	711	828	1782	721	352	45	4440
Pharmacies	0	0	0	0	0	0	0
Pharmaceutical Manufacturer	0	0	0	0	0	0	0
Total	892335	1003027	2641229	784255	264520	105215	5690582

Slight deviations in totals may occur due to rounding.

Table 17 - Summary of Waste Disposed of as Biomedical Waste, kg/year

Waste Material	M.O.H. Region						Ontario Total
	SW	CW	CE	E	NE	NW	
Human Anatomical	28761	39243	70150	30315	11363	4462	184293
Animal Waste	410	21490	7933	331	154	36	30354
Microbiological	203581	233223	940029	224059	83623	32640	1717155
Human Liquid Blood	166898	200341	771261	180655	50603	18776	1388534
Blood Contam. Biomedical	156768	182604	455743	118459	49078	19005	981657
Other Body Fluids	51474	63413	186240	50129	21577	8455	381288
Sharps	282879	330754	919716	302695	94027	36691	1966762
Total Biomedical Waste	890771	1071066	3351072	906643	310424	120065	6650042
Blood Contam. Non-Biomedical (Contiguous)	65804	72070	202770	60909	14235	5610	421398
Animal Carcasses	227244	491762	518731	222197	56572	13259	1529765
Pharmaceutical	25037	34638	160574	24654	14299	5346	264547
Non-Biomedical	892335	1003027	2641229	784255	264520	105215	5690582
Total Waste Disposed of as Biomedical	2101192	2672563	6874376	1998658	660050	249495	14556334

Slight deviations in totals may occur due to rounding.

5. DISCUSSION

The following discussion is organized in four parts:

- A discussion of the reasons for the choice of waste categories
- A discussion of the audit results
- A discussion of the results of the post audit interviews
- A discussion of appropriate disposal options for biomedical waste management in Ontario

5.1 Choice of Waste Categories

The choice of the waste categories used during the study was mainly derived from the biomedical waste classes outlined in the Proposed Definition of Biomedical Waste presented in Section 1. The other categories used (non-biomedical, contiguous, pharmaceutical and animal carcass wastes) within this report were chosen to develop data that can be used by MOE to more realistically determine what portion of the non-biomedical waste stream may also require special handling.

- Non-biomedical waste includes items such as packaging, pop cans, etc., that were disposed as biomedical wastes by the sites studied, and should be very easy to remove from the biomedical waste stream.

- Contiguous, or blood stained non-biomedical wastes may be wrongly disposed as biomedical by generators. The proposed definition includes "items that, if compressed, would release liquid or semi liquid blood". Items stained, but not sufficiently bloody to release blood when compressed, are considered non-biomedical waste.

This category was separated from other non-biomedical waste as it was felt that this would be a likely area of confusion for health care practitioners. Quantifying this allows consideration of additional biomedical waste management facility capacity to allow for some erroneous disposal of pieces as biomedical waste.

- Pharmaceutical waste is not considered biomedical according to the new proposed definition, but is currently disposed as biomedical waste by a number of generators. Other generators typically flush these wastes directly to the sewer. Currently, the most appropriate disposal option for pharmaceuticals is incineration.

- Animal carcasses, not infected by Schedule 5A agents, are not biomedical waste. Non-infected carcasses may be disposed as biomedical waste by some veterinarians or researchers as a precautionary measure or simply because there is no other disposal option available.

Pharmaceutical, blood stained non-biomedical and animal carcass waste quantity estimates will be very important in developing regional capacity requirements for biomedical waste management facilities. Quantities of these three categories of waste, when added to the true biomedical waste quantities estimated for the province, provide a maximum estimate of the quantities requiring treatment in regional facilities. Biomedical waste quantities and pharmaceuticals alone provide a minimum estimate of materials requiring disposal. Realistically, the actual amount of material requiring treatment will be within this range established by minimum and maximum estimates (viz about 6,915-8,866 tonnes/year).

5.2 Discussion of Audit Results

5.2.1 Factors Affecting the Data

The majority of the biomedical waste stream components generated at each of the sites audited were quantified through actual weighing and sorting. However, at some of the selected sites, normal operating practices resulted in certain components of the waste stream being unavailable for auditing. Examples of these operating practices included discharging blood, body fluids and pharmaceuticals directly to the sewer. At other sites, seasonality of generation rates made it impractical to audit wastes generated over a one week or one month period (i.e.during the summer months) and extrapolate these data to estimate yearly generation. Thus, for the sites and particular waste stream components affected, sites' staff provided estimates of quantities of waste generated. These sites and biomedical waste components included:

- **Human Blood**

Several sites, such as funeral homes, the coroner's office and some hospitals, reported managing human blood disposal by draining it directly to the sewer. This practice was done on a regular basis, resulting in the absence of blood and blood products from wastes audited. Staff from a number of these sites provided estimates of annual volumes generated.

- **Anatomical Wastes**

All anatomical wastes disposed of in biomedical waste containers were weighed. Materials which were not disposed immediately, such as those sent to the pathology department of the hospital for either further study or storage, (i.e. anatomical specimens for legal or medical teaching purposes), were estimated by sites' staff. Placentae, which were sent by the hospitals for extraction and research purposes, were not counted as part of the anatomical waste stream. Only those placentae currently disposed as biomedical waste were weighed and recorded.

- **Veterinary Clinics**

Biomedical and non-biomedical animal carcasses were treated in essentially the same way by all veterinary sites studied. In each location, they were incinerated. For all locations, with the exception of one laboratory, quantities were estimated via annual or monthly disposal records. For the laboratory exception, animal carcasses were weighed.

It was impractical for some veterinary offices and for the veterinary teaching and research facility studied to estimate annual generation of anatomical wastes based on a one week or four week audit. Some veterinarian offices indicated that the volume of operations varied on a seasonal basis. Similarly, the veterinary research and teaching facility's generation varied seasonally as well, based on student activity. Thus, for these facilities, annual generation was estimated by the sites' staff. Estimated data were limited to anatomical wastes for veterinary offices,

and included all wastes from the Ontario Veterinary College, which were provided via disposal records.

- **In-Home Nursing Providers**

The provision of home health care services may result in the generation of several types of biomedical wastes, including blood soaked dressings, needles and syringes, other sharps, liquid blood and other body fluids, as well as pharmaceuticals.

Selected regional in-home care offices were asked to estimate quantities of biomedical waste disposed of at patient homes. Many offices could not make such estimates. A few offices provided estimates but they ranged widely between regions. Thus, it was decided that only syringes and needles would be quantified in this component of the study. Estimates were derived via records for supplies purchased by each regional office, as described earlier in Section 2.1. Quantifying the other streams described would be difficult as they would vary depending on the level and type of care being offered to each patient and the population of in-home care patients in each region.

In addition to the estimates for syringes and needles, figures were supplied on liquid blood generation from the Head Office Reference Laboratory located in the Central East region.

- **Pharmacies**

The 15 pharmacies that responded to our request for information on biomedical waste (i.e. waste pharmaceuticals and sharps) generation, reported a variety of disposal methods currently being utilized. These included:

1. Sending pharmaceuticals back to the manufacturer
2. Flushing pharmaceuticals to the sanitary sewer
3. Storing pharmaceuticals and sharps which are picked up for biomedical waste disposal.

Many pharmacies could not estimate their generation of either pharmaceuticals or sharps. Most did not have sharps' return programs for their customers. Those that provided generation figures for biomedical materials used either rough estimates or records provided by contracted biomedical disposal forms. Further study would be necessary if more detailed estimates are desired. The results presented in Tables 11 and 15 are based on the best information we could obtain but are not considered precise.

- **Pharmaceutical Manufacturers**

Of those firms surveyed that provided information, none reported generation of animal carcasses, and one reported pharmaceutical generation as per disposal records. However, it may be possible that this waste stream includes a combination of off-spec packaging and

other materials associated with pharmaceutical development and packaging lines. This point may be worthy of further investigation. The other manufacturers surveyed indicated that they did not generate biomedical wastes in Ontario because their Ontario facilities were distribution locations only, or because their Ontario-based manufacturing lines did not generate biomedical waste. It became evident that the types and quantities of biomedical wastes generated by this sector were dependent on the products manufactured, and were company and facility specific.

Based on our survey, it is recommended that further research be conducted to more accurately quantify this sector's biomedical waste stream.

5.2.2 Discussion of Tables 5-16 Audit Results for the 11 Categories of Waste

- **Human Anatomical Waste (Table 5)**

  It should be noted that no teaching or large hospitals exist in the North East and North West regions. Therefore, no anatomical waste is shown for the generators in these regions.

  Essentially, all of the anatomical waste is generated by the hospitals. Very small quantities of anatomical waste were found by the audit team in isolated samples from funeral homes, and the central Coroner's office. These quantities were factored into the average composition of waste for each generator type and

aggregated regionally. Non-hospital generation estimates are about 0.006% of the total anatomical waste quantities.

- **Animal Wastes (Table 6)**

  As would be expected, animal waste was generated only by a small number of categories of generators engaged either in research or animal treatment.

- **Microbiological Waste (Table 7)**

  The generation of microbiological waste was all associated with facilities which have laboratories. A very small quantity was generated by the Coroner's Office in Toronto. The audit did not segregate microbiological waste by hazard level.

- **Liquid Blood (Table 8)**

  Not all liquid blood is disposed as biomedical waste. Several sites reported sewering liquid blood. These included some vets, some funeral homes, some hospitals, and the Coroner's Office. This audit was concerned only with wastes currently disposed of as biomedical waste. If there is concern about the practice of putting liquid blood to the sewer, an additional audit would be required to estimate quantities that would then be handled as biomedical waste.

The large quantity of liquid blood generated by the in-home care sector in the Central East region is disposed by the Head Office Reference Laboratory.

- **Blood Contaminated Biomedical Waste (Table 9)**

  It is likely that there will be some blood contaminated biomedical waste generated by the in-home care sector. This was not accounted for because, as noted previously, the in-home nursing providers could not provide us with estimates of quantities.

- **Other Body Fluids (Table 10)**

  The large figure for Private Research/Biotech in the Central East region is associated with the one facility that is included in this category of generators.

- **Sharps (Table 11)**

  As noted in the discussion about Pharmacies, the data on sharps generation from this source were not regarded as being precise. As a proportion of the total estimate for sharps generation, this is only 0.25%. Thus, even if the estimate was underestimated by as much as a factor of 10, the maximum difference would be 2-3% on top of the current quantity estimate.

- **Summary of Biomedical Waste Generation (Table 12)**

  This table is a summation of quantities repeated in Tables 5-11.

- **Blood Contaminated Non-Biomedical Waste (Table 13)**

  As for blood contaminated biomedical waste, no estimate was available for generation of this type of waste from the in-home care sector.

- **Non Biomedical Animal Carcasses (Table 14)**

  The majority of waste generated in this category comes from teaching hospitals, universities with medical research facilities, veterinarian clinics and the veterinary teaching facility. A very small quantity was measured at the Coroner's Office.

- **Pharmaceuticals (Table 15)**

  In-home care may generate pharmaceutical waste. No quantity estimates were available for this waste.

  The generation rate for pharmacies was estimated from data supplied by a limited number of pharmacists. As discussed previously, these estimates were quite approximate, because the pharmacist has the option of sewering or returning pharmaceuticals to pharmaceutical manufacturers instead of having to dispose of pharmaceuticals as biomedical waste. This

estimate represents about 6% of the total pharmaceutical waste estimate, so that changes in this estimate would have a moderate effect on the total estimate for pharmaceuticals.

Nearly 40% of the estimated pharmaceutical waste generation is from pharmaceutical manufacturers. As noted earlier, the estimates of biomedical waste generation from this sector are not considered precise.

Thus, nearly half of the estimated generation of pharmaceutical waste is not considered precise, and needs both further auditing and, possibly, a review of the acceptability of practices, such as sewering of waste pharmaceuticals.

- **Non-Biomedical Waste (Table 16)**

It should be noted that this refers only to non-biomedical waste disposed as biomedical waste, and does not reflect non-biomedical general waste generation rates.

Overall, the proportion of non-biomedical waste disposed as biomedical waste was 39% of the total estimated generation of biomedical waste using current practices. There was a range from finding 0% non-biomedical waste disposed as biomedical waste in doctor's offices to 68% for chronic care hospitals, about 48% for teaching hospitals, and 55% for small hospitals.

The in-home care generation of non-biomedical waste was again not accounted for because of lack of data availability.

5.3 Discussion of Results of the Post Audit Interview

During the course of the biomedical waste audits conducted for this study, ORTECH had the opportunity to speak with sites' staff regarding their impressions and concerns about the new proposed definition of biomedical wastes for Ontario. These conversations were followed up with a written post-audit questionnaire, reproduced in Appendix 3. Auditing staff also had the opportunity to put the new definition into practice and test its ease of application and clarity from a waste sorting point of view. This section is a summary and discussion of comments and issues arising out of the new biomedical waste definition from both sites' staff and audit staff. A total of 28 out of 43 post-audit questionnaires were completed, including 11 out of the 12 hospitals. All large, medium and teaching hospitals were completed using on-site interviews.

Comments and issues can be organized into various subject areas for discussion, including the content and wording of the definition, and the requirements and role to be played by the MOE and others in implementation of the biomedical waste strategy.

5.3.1 Content and Wording of the Definition

Several sites responded with comments regarding the definition document itself, i.e. the language used, clarity of various points and technical comments. Eight out of eleven hospitals reported difficulty in

interpretation, six smaller generators reported difficulties in fully understanding the definition, and six reported that they had never seen the definition.

With respect to language, the definition is written in language that will form the basis of a regulation, which some individuals engaged in generating and handling wastes may find difficult to interpret and understand. There may be justification for preparing a separate guideline to help interpret the definition.

With respect to clarity, there are several points that have been identified as requiring further explanation, including:

i) the statement that biomedical wastes include other wastes which 'are deemed by a trained person designated by the generator to require special handling'

The specific issue for sites on this point is that the term 'trained person' has not been defined in the document, (i.e. what type of training or level of responsibility is necessary). There may be a need for definition if there is a potential of assigning liability to a trained person, (subsequent to the audit, a decision was taken to modify the definition to delete reference to "trained person").

ii) the definition of "items contaminated with blood....", "sharps....", "body fluids", "cultures, stocks or specimens submitted for microbiological analysis" and "blood products"

- **Blood Contaminated Biomedical Wastes**

These wastes are described in the definition as 'items contaminated with blood that would release liquid or semi-liquid blood if compressed'. Both site staff and the audit team report difficulty in interpreting this definition for the following reasons:

- a commonly held misconception that the definition implies that wastes should be compressed to determine in which category (i.e biomedical or non-biomedical) they belong
- further difficulty in determining the degree to which materials need to be compressed for this determination
- questions regarding the degree to which materials need to be saturated or dripping to be classified as biomedical wastes, and difficulty in determining this degree with minimal handling of materials
- potential difficulties in segregating slightly blood contaminated waste and waste saturated with blood in surgical areas where there is little room for appropriate collection bins and minimal time for segregation procedures
- questions on whether or not blood laden bathroom wastes are classified as biomedical
- concern was expressed that items with minimal or dried blood would have the appearance of releasing liquid blood if mixed with non-biomedical liquids in the same bag

- **Sharps**

  Three hospitals are concerned that the current list of materials included as sharps, (i.e. needles, blades and glass or other materials capable of causing punctures or cuts) might be misinterpreted to allow, for example, the disposal of sharp plastics in regular garbage.

- **Body Fluids**

  Five hospitals reported uncertainty as to which body fluids are required to be treated as biomedical waste. In addition, whether to include sinovial and pareonatal fluids in biomedical wastes is uncertain. Even though the latter may be generated via a surgical procedure, and, as such, is included as a biomedical waste in the definition, it presents a minimal hazard of infection according to hospitals.

- **Culture, Stocks or Specimens Submitted for Microbiological Analysis**

  Medical laboratories question whether non-biomedical materials such as urine and faeces, when subjected to microbiological assessment, become biomedical. The definition states that specimens submitted for microbiological analysis are considered non-anatomical biomedical wastes.

- **Blood Products**

  Medical laboratories questioned whether equipment containing dried blood serum should be disposed of as biomedical waste.

With respect to technical input from participating sites, the following points were made:

- There is a concern from generators that the new definition may require clarification with respect to potential conflicts with other legislation, such as:
  - The Research for Animals Act
  - The Transportation of Dangerous Goods Act
- One hospital noted that, under Schedule 5B heading "Bacteria", Chalmydia psittaci and Coxiella burnetii cause diseases transmitted by animals and should be listed under 5A.
- Several hospitals report that they are reluctant to accept the new definition since they feel it allows for too much personal judgement on the part of sites' staff in classifying wastes and may result in an increased risk of improper disposal.
  - one hospital indicated it was unwilling to use the new definition
  - five hospitals indicated reluctance to use the new definition because of differing opinions to their current infection control practices, or because they felt it needed further clarification
  - three hospitals were concerned that the definition conflicted with other laws or guidelines

- two hospitals indicated no reluctance to adopt the new definition

5.3.2 Role to be Played by the MOE, MOH, OHA and Others In Implementation

Implementing the new definition will be challenging, and participating sites and audit staff believe it will require extensive educational programs to ensure the proper segregation of biomedical wastes.

Many sites audited as part of this study indicated in post-audit questionnaires that they were not completely familiar with all facets of the new definition. In some instances, (for example, 3 out of 5 vets) they were not at all aware of the existence of the new definition prior to the audit. Overall, 32% of respondents were not aware of the new definition prior to the audit.

It will be important to provide education to generating sites so that they may learn the details of the definition and understand and adopt it in their day-to-day procedures which generate wastes. This is the only way that proper segregation of biomedical and non-biomedical wastes can begin to occur. Most hospitals surveyed (9 out of 11) felt that an education program would be necessary to train staff. Suggestions were made that this training follow a standard format to ensure that all sites within a given generator category (i.e. hospitals, laboratories) are following the same procedures. There was concern expressed that there may be difficulty in training staff not to follow universal precautions which may differ from the new definition.

The MOE will need to begin discussions with municipalities and others who collect wastes at curbside from biomedical waste generators, or dispose of it at area facilities. These individuals will need to be briefed on the definition and its impact on their operations (i.e. the increased presence of contiguous wastes, etc., in curbside garbage which is destined for disposal). Currently, these groups have strict guidelines for hospitals and veterinarians, etc., prohibiting various materials from wastes, for example, IV tubing, autoclaved materials, syringes, vitamins, animal blood laden dressings, etc., depending on the specific area.

Other areas of note in the questionnaire responses, where the MOE and others could play a role to facilitate the smooth implementation of the definition include:

- The provision of a complete list of licensed biomedical waste handlers to all generating sites to allow these sites to conduct more complete investigations into contracts and costs for disposal services.
- The development of standards for sharps containers to be utilized in Ontario.
- The provision of education on the definition to public health departments.
- The provision of promotional and educational materials (i.e. posters, etc.) on the definition to generator sites.

Ten hospitals indicated they would like to see a 'standardized education' approach to implementation of the new definition.

Ten sites indicated they would like actual hep in implementation (e.g. to deal with conflicting municipal bylaws, etc., or concerns with public perception).

It should be noted that MOE already plans to update its Biomedical Waste Guideline to further clarify both definitions and practices.

5.4 Discussion of Appropriate Disposal Options for Biomedical Wastes in Ontario

The most appropriate method of disposal for anatomical wastes, pharmaceutical wastes, animal carcasses generated through research, and some microbiological wastes (such as those from level 3 and 4 laboratories).is incineration. Since the audit did not separate level 3 and 4 microbiological wastes from Level 1 and 2 wastes, no estimate is available for the quantity of this specific type of microbiological waste. The sum of anatomical and pharmaceutical waste, plus animal carcasses from research, is 1,979 tonnes/year. Because this total does not include any microbiological waste, it should be considered as a minimum estimate for incineration capacity.

For other biomedical waste categories, non-incineration waste treatment options may be considered. The sum of the generation estimates all of these categories (including all microbiological waste measured) is 6,466 tonnes/year. In estimating the total treatment capacity required for this type of waste, it is suggested that the contiguous (blood contaminated, non-biomedical waste) be included in the estimate. While this waste is definitely not biomedical according to the definition, it is the most likely waste to be wrongly disposed as biomedical. Therefore, it is

suggested that an additional 421 tonnes/year of treatment capacity be considered to accommodate this. The total waste, as audited, requiring special non-incineration technology would then be 6,887 tonnes/year.

Tables 18 and 19 break down the biomedical and contiguous biomedical waste stream quantity estimates derived via this study for Ontario, according to the disposal options currently recognized by the MOE as most appropriate (i.e. incineration and non-incineration treatment). Tables 18 and 19 provide estimates for quantities requiring disposal via each of the two disposal options in each of the MOH planning regions, (in tonnes/year and tonnes/day, respectively). These two tables are specifically designed to assist in planning appropriate incineration and non-incineration treatment facility capacities. Since this involves another segregation step for hospitals (viz separation into incinerable vs non-incinerable biomedical wastes), which is currently not covered by the definition, there will have to be additional guidance offered to hospitals as to how to make this distinction.

Table 18
Biomedical Waste Quantities for Treatment or Incineration in Ontario
Estimated Generation in tonnes/year

Treatment Method	M.O.H. Planning Region						Total
	SW	CW	CE	E	NE	NW	
Incineration	281.0	565.6	749.5	277.2	82.2	23.1	1978.6
Non-Incineration Treatment	927.8	1103.9	3483.7	937.2	313.3	121.2	6887.1
Total	1208.8	1669.5	4233.2	1214.4	395.5	144.3	8865.7

Table 19
Biomedical Waste Quantities for Treatment or Incineration in Ontario
Estimated Generation in tonnes/day *

Treatment Method	M.O.H. Planning Region						Total
	SW	CW	CE	E	NE	NW	
Incineration	0.9	1.9	2.5	0.9	0.3	0.1	6.6
Non-Incineration Treatment	3.1	3.7	11.6	3.1	1.0	0.4	22.9
Total	4.0	5.6	14.1	4.0	1.3	0.5	29.5

* Based on 300 days / year operation

Slight deviations in totals may occur due to rounding.

6. CONCLUSIONS AND RECOMMENDATIONS

This section summarizes key conclusions and recommendations resulting from the study.

6.1 Conclusions

The estimates of biomedical waste generation resulting from this study are based, for the most part, on directly audited sample locations, or on reliable data supplied to the audit team and on complete aggregation data. From this, we conclude that these estimates for biomedical waste currently disposed in the province of Ontario are reliable. The exception to this is the data estimated for pharmaceutical manufacturers in the province. These data have been reported as incomplete. Although several large manufacturers were surveyed, only a few responded, and little data were made available for this study. Key issues in quantifying wastes from this sector include identification of firms with manufacturing operations inside Ontario borders, and understanding the various types of processes operating which result in significantly different types of waste generated.

Of the estimated 14,556 tonnes/year of waste currently disposed as biomedical, 5,690 tonnes/year (or 39%) is non-biomedical. Hospitals account for 5,117 tonnes/year or nearly 90% of the non-biomedical waste currently disposed as biomedical waste. Proper segregation of this waste should result in significant savings in waste management costs.

Of the other 8,866 tonnes/year of waste disposed as biomedical, 6,650 tonnes/year are biomedical according to the new MOE definition; 1,530 tonnes/year are animal carcasses; 265 tonnes/year are pharmaceutical and 421 tonnes/year are a category we called "contiguous" biomedical waste. This contiguous waste category is bloodstained but non-biomedical, and is considered separately from other non-biomedical because it was concluded that this category of waste might be the most likely to be erroneously disposed as biomedical. It might be concluded that this should be included under the definition, but doing this may lead to other difficulties since this item would then include items such as used feminine hygiene products under the definition of biomedical waste. Instead, our conclusion is that the MOE and MOH, in planning the capacity of disposal facilities, should consider this "contiguous biomedical" waste category as potentially requiring treatment.

Of the total 8,866 tonnes/year discussed above, 1,979 tonnes/year were concluded to require incineration according to MOE's current guidelines. The balance requires special handling, but could be managed using alternative treatment technologies, such as autoclaving, microwave sterilization, etc. The proposed Biomedical Waste Management Strategy, released in June, 1992, suggests establishing 6 Regional Treatment Facilities, one in each of the MOH regions of the province. The estimates of waste quantities generated that would require incineration, shown in Table 19, suggest a generation rate of only 6.6 tonnes/day for the whole province, which may not be sufficient to justify 6 regional incinerators.

For a number of reasons, however, it is suggested that consideration be given to increasing the design capacity for incineration:

a) collecting an "incineration" stream will require a further segregation step within the hospital which was not tested as part of this audit

b) data on biomedical waste generation from pharmaceutical manufacturers was not complete so that the estimate of pharmaceutical waste generation may be underestimated

c) changes in practice of pharmaceutical waste management may result in increased quantities of pharmaceuticals for disposal

d) the audit did not quantify the Level 3 and 4 microbiological waste that may require incineration.

Even allowing for an increase over the estimated generation rate of 6.6 tonnes/day of incinerable waste, it is suggested that consideration be given to rethinking the strategy of complete treatment facilities in every region. This is particularly important in regions generating very small quantities, i.e. North East and North West.

Site audits, conversation with staff at participating generator locations, and a review of responses from these sites to the post audit questionnaire provided information on perceived difficulties in understanding and implementing the biomedical waste definition.

Key points raised included clarity of definition of "trained person", (taken out of the definition subsequent to the completion of the study) and material categories, such as sharps, body fluids, microbiologicals, blood contaminated biomedical and blood products. Potential conflicts with

other legislative initiatives were also indicated as a concern. Many sites concluded that the MOE, MOH, OHA and other associations would need to play a key role in educating generators about the definition and assist in helping them implement it effectively.

6.2 Recommendations

1. The wording of the proposed definition should be examined and amended to further clarify technical points raised as a result of the survey, such as:

   - The definition of materials included as sharps
   - The definition of body fluids
   - The definition of microbiological specimens
   - The definition of blood contaminated biomedical such that it is easy to apply objectively.

2. If only certain biomedical wastes are to be incinerated, these should be defined, segregation practices within the overall category of "Biomedical Wastes" established, and guidelines produced for the hospitals.

3. In considering design capacity for biomedical waste that will be treated by alternative technologies, an additional capacity of 421 tonnes/year be included. This will account for the contiguous blood stained non-biomedical waste which, in our opinion, is the

most likely category to be erroneously disposed as biomedical waste.

4. Consideration should be given to establishing design capacities for biomedical waste incinerators in the province higher than the estimated incinerable waste generation rates. This recommendation is based on an anticipation of an incomplete segregation of incinerable from non-incinerable biomedical wastes, and on an anticipation of increases in pharmaceutical waste over the estimated generation rate.*

5. Further research should be conducted to more accurately quantify generation of biomedical wastes from pharmaceutical manufacturing processes in the province.

6. Further research should be conducted to examine current disposal practices for pharmaceuticals in the province to determine whether changes in these practices should be recommended, which would increase the quantities of pharmaceutical waste requiring incineration.

7. Hospitals should use the information from this report to estimate, from their own biomedical waste generation rates, how much of this is likely to be non-biomedical; and, from this information, examine opportunities for better segregation practices.

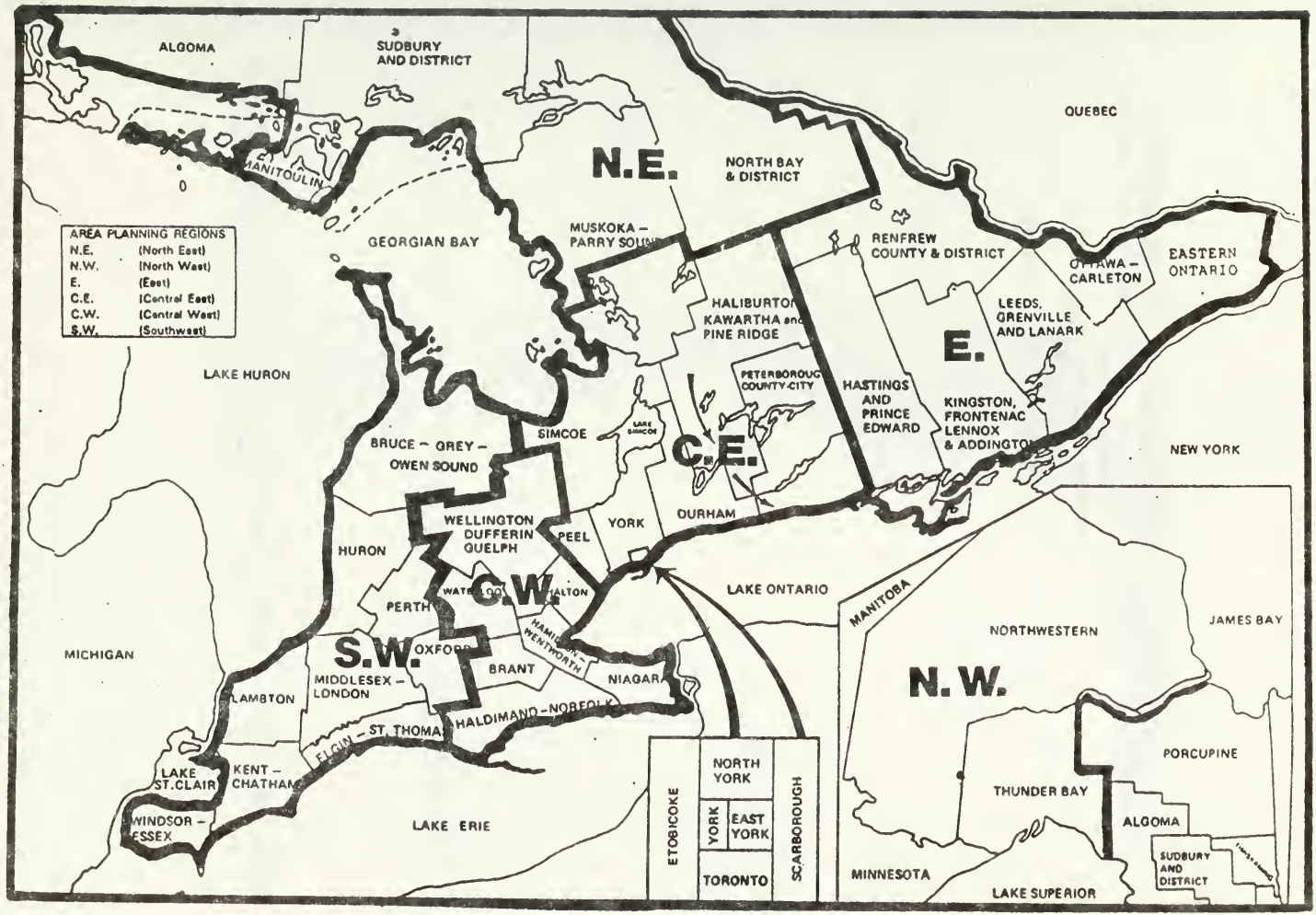
*(Currently only human anatomical waste is segregated from other biomedical waste. The other designated incinerable waste categories are currently disposed with other biomedical waste.)

APPENDICES:

1. Ministry of Health Regions
2. Breakdown of Hospital Sections
3. Post Audit Questionnaire
4. Ontario Regulation 309
   Draft Schedules 5A and 5B

APPENDIX 1: Ministry of Health Regions

Fig. 1 Ministry of Health Planning Regions



APPENDIX 2: Breakdown of Hospital Sections into:

Patient Care
Patient Services
Laboratories
Support/Administration

The hospital data were divided into four sections: Patient Services, Patient Care, Laboratories and Administration/Support Services. Examples of these categories are outlined below.

Examples of Patient Care areas include bed areas such as:

- Intensive Care Units
- Pulmonary, Cardio
- Gynecology
- Orthopedics
- Surgery
- Chronic care units

Examples of Patient Services areas include:

- Cardiopulmonary
- Gastrointestinal Unit
- Nuclear Medicine
- Radiology
- Cancer Clinics
- Dialysis
- Emergency
- Labour and Delivery
- Pharmacy
- Surgery
- Ambulatory
- Recovery

Examples of Laboratories include:

- Biochemistry
- Blood Bank
- Hematology
- Microbiology
- Oncology
- Pathology
- Research Lab

Administration and Support Services generate little biomedical waste. Examples of these areas include:

- Engineering
- Decontamination
- Drug Store
- Housekeeping
- House Services
- Locker Rooms

Note: The categories Admin, Patient Care (PC), Patient Services (PS) and LAB will differ between hospitals as a result of differing specializations.

APPENDIX 3: Questionnaire for Post-Audit Interviews

QUESTIONNAIRE FOR POST-AUDIT INTERVIEWS

1. What is your internal definition of biomedical waste?

2. Are you familiar with the new biomedical waste management strategy for Ontario?

3. Are you familiar with the purpose of the new biomedical waste management strategy?

4. How will this new strategy affect your operation?

5. How does the definition in (1.) differ from the proposed new MOE definition?

6 Are the descriptions of material categories listed in the new proposed definition of biomedical waste clear to you?

7. Do you understand the difference between material which is deemed biomedical and non-biomedical, by the Ministry of the Environment?

8. Are you clearly able to apply these definitions to your own waste stream components to ascertain what materials are, and are not defined as biomedical waste?

- If not, which areas of the definition require further clarification? Are these clarifications based on -

  i) Difficulties in discerning whether certain material types belong in the definition or not (i.e. types of liquid wastes, pharmaceuticals, serums ...)

  ii) Degree of contamination (i.e. how much blood contamination is required to classify an absorbent material as biomedical waste)

  iii) Difficulties in discerning which category of biomedical waste a material fits into (i.e. is it microbiological if it is generated in the lab, what is a sharp, etc.)

9. Are you willing to adopt the new MOE definition for use throughout your facility?

If not, why not? Please specify whether reasons are related to -

i) intellectual differences of opinion - please specify
ii) staff training issues - please specify
iii) staff compliance, safety, infection control etc. - please specify
iv) local waste collection or disposal requirements which conflict with the new definition - please specify
v) other legislative requirements which conflict with this new definition - please specify
vi) other - please specify

Note for the interviewer: details on any of these issues are imperative in understanding problems anticipated by the generator, and in resolving them.

10. With respect to (9.), do you feel you are fairly representative in your views and opinions in this matter, to other members of your particular industry sector (i.e. hospitals, veterinarians or funeral homes, etc.) - Please specify

11 If the implementation of this new definition at your facility requires changes in practices, what will your approach consist of?

12. Do you foresee difficulties in implementing the new definition? If so, what assistance would help , i.e.,

- staff training materials and programs
- promotional materials
- equipment
- assistance in negotiating with disposal facilities or municipal collection programs
- other - please specify

13. What role could the MOE play in ensuring the smooth implementation of this new strategy and definition at your facility and similar facilities?

APPENDIX 4: Ontario Regulation 309
Draft Schedules 5A and 5B

Ontario Regulation 309

Draft Schedule 5A

Agents of Biomedical Animal Wastes

Bacteria

Bacillus anthracis
Brucella - all species
Francisella tularensis, type A (biovar tularensis)
Mycobacterium avium; M. bovis (non-BCG strains); M. tuberculosis

Pseudomonas malleri; P. pseudomallei
Yersinia pestis

Viruses

Viruses are grouped within Family and / or Genus. Anthropod-borne viruses are identified with a double asterisk.

Arenaviridae
Lymphocytic choriomeningitis virus, neurotropic strains

Bunyaviridae
Unclassified Bunyavirus
Hantaan, Korean hemorrhagic fever and epidemic nephrosis viruses

Herpesviridae
Gammaherpesvirinae
Genus Rhadinovirus: Herpesvirus ateles; Herpesvirus saimiri

Retroviridae
Oncovirinae
Genus Oncornavirus C
Human T-cell leukemia/lymphoma virus (HTLV-I, HTLV-II,if cultured)
Genus Oncornavirus D
Mason-Pfizer monkey virus
Viruses from primates
Lentivirinae
Human immunodeficiency viruses (HIV - all isolates if cultured)

Rhabdoviridae
Genus Vesiculovirus
Piry
Genus Lyssavirus

Agents of Biomedical Animal Wastes - Page 2

Rabies, street virus

Togaviridae
- Genus Alphavirus**
  - Eastern equine encephalitis virus
  - Chikungunya (recent isolates)
  - Venezuelan equine encephalitis (except Strain TC-83)

Unclassified Viruses
- Chronic infectious neuropathic agents (CHINAs)
  - Kuru, Creutzfeldt-Jakob agent (also listed under Level 2; level of the suspected agent depends on the nature of the manipulations and the amount of sera, bio/necropsy materials handled)

Arenaviridae
- Lassa, Junin, Machupo viruses

Bunyaviridae**
- Genus Nairovirus
  - Crimean-Congo hemorrhagic fever

Filoviridae
- Marburg virus
- Ebola virus

Flaviviridae**
- Tick-borne encephalitis complex, including -
  - Russian Spring-Summer Encephalitis
  - Kyasanur forest virus
  - Omsk hemorrhagic fever virus

Herpesviridae
- Alphaherpesvirinae
  - Genus Simplexvirus: Herpes B virus (Monkey B virus)

Poxviridae
- Genus Orthopoxvirinae
  - Variola
  - Monkeypox

Ontario Regulation 309

Draft Schedule 5B

Agents of "Other" Biomedical Wastes Requiring Special Handling

Bacteria

Chlamydia psittaci

Rickettsi
Coxiella burnetii

Viruses

Arenaviridae
Lassa, Junin, Machupo viruses

Bunyaviridae**
Genus Nairovirus
Crimean-Congo hemorrhagic fever

Filoviridae
Marburg virus
Ebola virus

Flaviviridae**
Tick-borne encephalitis complex, including -
Russian Spring-Summer Encephalitis
Kyasanur forest virus
Omsk hemorrhagic fever virus

Herpesviridae
Alphaherpesvirinae
Genus Simplexvirus: Herpes B virus
(Monkey B virus)

Poxviridae
Genus Orthopoxvirinae
Variola
Monkeypox